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SMITHSONIAN INSTITUTION  
UNITED STATES NATIONAL MUSEUM

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# PROCEEDINGS

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## ADVERTISEMENT

The scientific publications of the National Museum include two series, known, respectively, as *Proceedings* and *Bulletin*.

The *Proceedings*, begun in 1878, are intended primarily as a medium for the publication of original papers, based on the collections of the National Museum, that set forth newly acquired facts in biology, anthropology, and geology, with descriptions of new forms and revisions of limited groups. Copies of each paper, in pamphlet form, are distributed as published to libraries and scientific organizations and to specialists and others interested in the different subjects.

The dates at which these separate papers are published are recorded in the table of contents of each of the volumes.

The present volume is the ninety-sixth of this series.

The *Bulletin*, the first of which was issued in 1875, consists of a series of separate publications comprising monographs of large zoological groups and other general systematic treatises (occasionally in several volumes), faunal works, reports of expeditions, catalogs of type specimens, special collections, and other material of similar nature. The majority of the volumes are octavo in size, but a quarto size has been adopted in a few instances in which large plates were regarded as indispensable. In the *Bulletin* series appear volumes under the heading *Contributions from the United States National Herbarium*, in octavo form, published by the National Museum since 1902, which contain papers relating to the botanical collections of the Museum.

ALEXANDER WETMORE,  
*Secretary, Smithsonian Institution.*

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## REVIEW OF THE SPIDER MONKEYS

By REMINGTON KELLOGG and E. A. GOLDMAN

Field studies have shown that the forest-inhabiting spider monkeys of the New World are subject to plasmodial infections under natural conditions and consequently, since they are readily obtainable, are now being used in laboratory studies of the malaria plasmodium. Spider monkeys are readily tamed and very adaptable to a life in captivity. Owing to their docility they are easily handled by laboratory assistants, and it is not difficult to provide suitable vegetable food for them. For these reasons it is important to establish, if possible, the valid geographic races of these monkeys, to determine in so far as available collections permit the geographic ranges of the recognized forms, and to set forth the characteristics by which the several races can be recognized with some degree of certainty.

The spider monkeys form a compact group, or subfamily, the *Atelinae*, of the primate family *Cebidae*. They are characterized by slender body, very long, slender limbs, and long tail, naked beneath distally and prehensile; the hand has only four functional fingers, the thumb being usually vestigial or absent.

These monkeys, in structure and habits, show high specialization and adaptation to a strictly arboreal life. They are limited in range to the unbroken tropical forests from southern Mexico to northern Matto Grosso, Brazil, and central Bolivia in South America. In the forest areas inhabited, often including steep mountain slopes, large trees have interlocking branches through which the spider monkeys are able to travel in long leaps at amazing speed, using the tail constantly as a powerful grasping organ for balancing, and swinging to differing levels. A spider monkey in a cage is seen at a disadvantage

compared, for example, with so active an animal as the gibbon, but the reason for this seems to be that room is lacking for the exercise of its full powers. It is interesting to speculate on the comparative speed that might be attained under natural conditions by these widely different but both outstandingly active New World and Old World representatives, respectively, of the order to which they belong. In following spider monkeys in the forest a man may keep up by running if the ground is clear, but if impeded by having to go around underbrush he is quickly left behind. Spider monkeys are considered very good to eat by the native populations of many countries and are, therefore, in danger of extermination.

Many names for spider monkeys have been based on inadequate descriptions of animals from unknown localities, and if a type specimen was used it may no longer be extant. The result has been great confusion in the literature bearing on the identification of material, and of the distribution of the nominal species recognized little has been known.

The status even of the generic name *Ateles* has been open to question. The spider monkey *S[imia] Sapajus paniscus* was included among the 14 monkeys allocated to *Sapajus* when this subgenus was proposed by Kerr (The Animal Kingdom, Cl. I, Mammalia, p. 76, 1792). No genotype seems to have been designated for the subgenus *Sapajus* Kerr, unless the statement made by J. A. Allen (Bull. Amer. Mus. Nat. Hist., vol. 7, p. 181, June 20, 1895) that *Sapajus* of Kerr is equivalent to *Cebus* Erxleben, 1777, can be interpreted as restricting the application of the term *Sapajus* to the species of *Cebus* included among the 14 monkeys mentioned above. In order to eliminate any possible misinterpretation, the genotype of *Sapajus* Kerr is here designated as *S[imia] Sapajus capucinus* Kerr (*op. cit.*, p. 78, 1792), which is the same as *S[imia] capucina* Linnaeus, 1766 (*nec* 1758). Inasmuch as the genotype of *Cebus* Erxleben, 1777, has been fixed (Elliott, Field Columbian Mus. Publ. 115, zool. ser., vol. 8, p. 560, Mar. 4, 1907) by subsequent designation as *Simia capucina* Linnaeus, 1766 (*nec* 1758), which in turn is equivalent to *Cebus nigrivittatus* Wagner (see Cabrera, Rev. Soc. Argentina Cienc. Nat., vol. 16, pp. 21-22, 1939), *Sapajus* Kerr is herewith relegated to the synonymy of *Cebus* Erxleben.

Neither opinion 147 (On the principles to be observed in interpreting article 34 of the International Code in relation to the rejection, as homonyms of generic and subgeneric names of the same origin and meaning as names previously published, Opinions and declarations rendered by the International Commission on Zoological Nomenclature, London, vol. 2, pt. 14, pp. 123-132, Sept. 30, 1943) nor article 34 (International rules of zoological nomenclature, Proc. Biol. Soc. Washington, vol. 39, p. 86, July 30, 1926) contains an express ruling as to whether a

given generic name is a homonym of another previously published generic name that has the same origin and meaning but that differs from the latter in more than one letter. If the "one letter" rule is strictly adhered to, then *Sapajou* Lacepède (Tableau des divisions, sous-divisions, ordres et genres des mammifères, p. 4. Published as supplement to Discours d'ouverture et de clôture du cours d'histoire naturelle, et tableaux méthodiques des mammifères et des oiseaux, 1799) is the oldest available name for the spider monkeys. The genotype of *Sapajou* Lacepède is *Sapajou paniscus* Lacepède = *Simia paniscus* Linnaeus. Pending an opinion from the International Commission on Zoological Nomenclature, the generic name *Ateles* E. Geoffroy (Ann. Mus. Hist. Nat. Paris, vol. 7, p. 262, 1806), of which the genotype is likewise *Simia paniscus* Linnaeus, is here retained for the spider monkeys.

We have been unable to reach any satisfactory conclusions regarding the identity of one of the described spider monkeys allocated to this genus. The "Antigua Monkey" was described by Pennant (History of quadrupeds, vol. 1, p. 206 (no. 212), 1781) as follows:

M[onkey] with a short nose; black face, hair on each side long; back and sides orange and black, intimately mixed; belly white; outside of legs black; inside ash-colored; tail of a dusky ash; its length 20 inches; that of body eighteen.

Lately in possession of Richard Morris, Esq. of the Navy-Office; brought from Antigua; but its native place uncertain; very good-natured, lively, and full of tricks; frequently hung by its tail.

This monkey subsequently became the basis for [*Simia*] *Sapajus variegatus* Kerr (The Animal Kingdom, p. 79, 1792) and *Simia antiquana* Bechstein (Thomas Pennant's Allgemeine Uebersicht der vierfüssigen Thiere, vol. 1, p. 227, footnote, 1799). In our judgment these names apply clearly to a spider monkey, and quite likely to one of the Middle American subspecies, but since the characters given are not sufficient to identify the race positively, we believe both should be held unidentifiable. Since *Ateles variegatus* (Kerr) antedates *Ateles variegatus* Wagner, the latter being preoccupied must be supplanted by *Ateles belzebuth* E. Geoffroy, which also has priority.

Despite strongly contrasting patterns of color, differing lengths of pelage, and to some extent varying tail and foot proportions, the striking similarity of all the spider monkeys in the more essential cranial features seems to indicate close relationships. The nominal species are here reduced to four, and it seems to us probable that additional study of the genus based on more complete collections may result in a further lessening of the number. The most divergent forms are the black *paniscus* of French Guiana and the silvery-bellied *yucatanensis* of Quintana Roo. Perhaps the most clearly defined line of demarcation between species, as we understand them, is in eastern Panama, where the range of the deep reddish *panamensis*, a member of the

*geoffroyi* group, meets or closely approaches the range of the nearly all black *robustus*. The Rio Amazonas, however, seems to be an effective barrier separating the ranges of *A. paniscus paniscus* and *A. belzebuti marginatus*.

Several large series of specimens from the same locality have afforded us much information concerning the range of individual variation that may be expected in the genus *Ateles*. The thumb is normally represented by a short metacarpal, which ordinarily is not visible externally. When, in occasional individuals, a short proximal phalanx is retained it constitutes the vestigial nailless thumb. In two specimens of *vellerosus* (U. S. N. M. Nos. 74662, 74663) from Santa Efigenia, Oaxaca, and in one of the same form (A. M. N. H. No. 123282) from Cantoral, Honduras, these thumbs are present on one hand and not on the other. In one of *panamensis* (A. M. N. H. No. 141980) from Cañas Gordas, Costa Rica, the thumbs are present on both hands. In a specimen of *hybridus* from Guaimaral, Colombia, vestigial thumbs on both hands bear small nails. Lönnberg (Arkiv för Zool., vol. 32A, No. 25, p. 8, July 18, 1940) describes a well-developed thumb with a well-developed nail on one hand only in a specimen of *paniscus*, a small thumb present on the other hand being nailless. All three specimens of *paniscus* (A. M. N. H. Nos. 94134, 94135, 94136) from Rio Jamundá, near Faro, on the north bank of the Rio Amazonas, have thumbs on both hands, as already recorded by Tate (Bull. Amer. Mus. Nat. Hist., vol. 76, p. 215, Oct. 20, 1939). Two others from Lago Cuipeúa, farther east on the same bank of this river, however, are thumbless. Lönnberg (*op. cit.*) refers to the absence of thumbs in specimens of *Ateles ater* [= *chamek*] from various localities, but they are present on both hands in a skin (C. M. No. 2775) from Río Yapacani, Santa Cruz, Bolivia. The evidence thus presented indicates that vestigial thumbs occur irregularly throughout the genus, and no specific significance is attached to their presence or absence.

Certain cranial details believed by some authors to represent distinctive characters prove to be too variable to be of much value. As Lönnberg (*op. cit.*) has pointed out, some of the features mentioned as characters by Tate (*op. cit.*) in comparing species are subject to a wide range of variation. The antorbital or "malar foramen" varies from one or two "pin-holes" to rounded openings 5 mm. in diameter through the jugal. These often differ in size and number on the two sides of the same skull. Tate also refers to "small, triangular pterygoids without pointed tips" as a cranial character in *paniscus*. In the Cebidae the fossae between the true pterygoids and their external reduplications are large and deep in *Cebus*, reduced to a vestige in *Alouatta*, and entirely wanting in *Ateles*. The external reduplications of the pterygoids have the tips broken off in the

specimens of *paniscus* examined by Tate, but these winglike thin plates are in reality larger and more extended posteriorly in these and in other specimens of *paniscus* from the Amazonian region than usual in this genus. Other characters that have been ascribed by Tate to *paniscus* but that have not been found to be constant are the small size of postglenoid processes, unexpanded zygomata of nearly uniform depth, and narrow teeth. The maxillary tooth rows in the genus as a whole are normally straight and convergent anteriorly, although skulls with parallel or arcuate tooth rows are less frequently observed. All the teeth in the maxillary tooth rows may be large or small, and the individual teeth vary in size in relation to one another. The posterior molars appear to be the most variable. They are usually similar to the first premolars in crown area but may be either larger or smaller. Examination of a large number of spider-monkey skulls shows that the cranial and dental features mentioned are subject everywhere to about the same wide range of individual variation. Schultz (Journ. Mammalogy, vol. 7, No. 4, pp. 286-305, Nov. 1926) has discussed the relative ranges of variation in skull measurements and in the formation of the forehead in a series of *Ateles* taken in the immediate vicinity of one camp on the bank of the Río Yoya in Nicaragua.

Beyond the general similarity and the range of the usual individual variation in the forms of *Ateles* there are, however, a few cranial features that seem to be worthy of consideration. All the races of *Ateles geoffroyi* agree closely in the more important cranial details, but in the more northern subspecies *vellerosus* and *yucatanensis* the brain case is slightly narrower than in *panamensis* and other Middle American races. The South American species *A. paniscus* and *A. belzebuth* have a longer rostrum, a more strongly inclined backward facial profile, and more elongated nasal openings than *geoffroyi*. In *paniscus*, which appears to be the most divergent in cranial details, the posterior upper molars scarcely reach the transverse plane of the anterior roots of the zygomata, while in *geoffroyi* they normally pass well beyond this plane; other peculiar characters in *paniscus* are the broad, somewhat swollen base of the rostrum and the posterior extension of the external reduplications of the pterygoids. In cranial details, as well as in geographic position, *Ateles fusciceps robustus* is somewhat intermediate between *geoffroyi* and *paniscus*.

Specimens examined in series have shown that although spider monkeys present considerable variation in color the variation is within limits beyond which it does not normally pass, except as the usual intergradation that may be expected between regional races or subspecies. The coloration, length of pelage, and other external features, when determined by examination of specimens in sufficient numbers, prove to be more reliable indices to subspecific relationship

than any cranial characters found by us. In Middle America, for example, skulls of *vellerosus* from Mexico are distinctly narrower, with less noticeable widening of the brain case, than those of *panamensis*, but differ little in other respects and despite great differences in color are obviously assignable to the same species. Unlike many other primates the sexes in the spider monkeys differ little, if at all, in size. One of the largest skulls of *geoffroyi* is that of an old female from Lavala, Nicaragua.

For loan of pertinent material our thanks are tendered to the following: Dr. Thomas Barbour, director, and Barbara Lawrence, Museum of Comparative Zoology, Cambridge, Mass.; Dr. Adolph H. Schultz, Laboratory of Physical Anthropology, Johns Hopkins Medical School, Baltimore, Md.; Dr. H. E. Anthony and George G. Goodwin, American Museum of Natural History, New York, N. Y.; J. Kenneth Doult, Carnegie Museum, Pittsburgh, Pa.; Dr. H. C. Oberholser, Cleveland Museum of Natural History, Cleveland, Ohio; Dr. William H. Burt, University of Michigan, Museum of Zoology, Ann Arbor, Mich., and to the latter also for the opportunity to examine specimens in the Donald R. Dickey collection.

In lists of specimens examined, the following abbreviations are employed:

- A. H. S., Collection of Dr. Adolph H. Schultz.
- A. M. N. H., American Museum of Natural History.
- C. D., Collection of Donald R. Dickey.
- C. M., Carnegie Museum.
- C. M. N. H., Cleveland Museum of Natural History.
- M. C. Z., Museum of Comparative Zoology.
- U. M. M. Z., University of Michigan, Museum of Zoology.
- U. S. N. M., United States National Museum.

All measurements are in millimeters. The external measurements were taken in the flesh by the collector as follows: *Total length*, nose to end of terminal vertebra; *tail*, upper base of tail to end of terminal vertebra; *hind foot*, back of heel to end of longest nail on digit. The following cranial measurements of typical adults, unless otherwise stated, were taken with vernier calipers by the authors: *Greatest length*, distance from anterior tip of premaxillae toinion or extreme posterior median point of brain case; *orbital* width, distance between outer margins of orbits; *postorbital constriction*, least width at constriction behind orbits; *width of brain case*, greatest width of brain case at or over mastoids; *zygomatic breadth*, greatest distance between outside surfaces of zygomata; *maxillary tooth row*, distance from front of canine to back of posterior upper molar at alveolar borders.

The following treatment is based on a review of the scattered literature and an examination of 251 specimens representing all the recognized species. The work has been done at the request of the Board for the Coordination of Malarial Studies of the National Re-

search Council in the laboratories of the Division of Mammals and of the U. S. Fish and Wildlife Service in the United States National Museum. The maps were drawn by Mrs. Katheryne C. Tabb, of the Fish and Wildlife Service. This review is intended to afford a working knowledge of the genus, pending more exhaustive revision as the species become better known.

### KEY TO SPIDER MONKEYS (GENUS ATELES)<sup>1</sup>

**A.** General coloration of entire back chiefly black.

**B.** Back and belly, as well as limbs and tail, wholly deep glossy black.

**C.** Hairs on head wholly black (except for short, white mustache whiskers on upper lip and sparse, short, white chin whiskers); pelage deep glossy black.

**D.** Foot rather large (length, heel to end of longest toe, 190–220 mm.).

**E.** Tail normally bushy in adult (especially on upper basal half, longest hairs on upperside 50–100 mm. in length); face normally flesh color, occasionally freckled or black; hairs on back silky, lax, and long (majority of hairs on midline of back 75–150 mm. in length); tail often more than twice length of head and body. (North bank of Amazon east of Manáos and north to Caribbean coast of Guianas.)

**paniscus**

**EE.** Tail much less bushy but more densely furred in adult (longest hairs on upperside 40–65 mm. in length); face wholly black; hairs on back shorter (majority of hairs on midline of back 75 mm. or less); tail often more than twice length of head and body. (Western Matto Grosso, eastern Bolivia, and north-eastern Peru to Rio Solimões and Rio Juruá, Brazil.)— **chamek**

**DD.** Foot smaller (length, heel to end longest toe, 160–170 mm.); tail not noticeably bushy (the longest hairs on upperside 30–50 mm. in length); face wholly black, except for short, white mustache whiskers on upper lip and sparse, short, white chin whiskers; hairs on back harsh and of medium length (majority of hairs on midline of back 40–70 mm. in length); tail variable in length, occasionally nearly twice as long as head and body. (Serranía del Darién, Panama, to southwestern Colombia.)— **robustus**

**CC.** Hairs on head not wholly black; semilunar forehead patch and side whiskers on face white; remainder of body, limbs, and tail deep glossy black; foot medium (length, heel to end longest toe, 170–185 mm.); tail variable in length, occasionally more than twice as long as head and body. (State of Pará, Brazil, south of Amazon, between Rios Tapajóz and Tocantins.)— **marginatus**

**BB.** Back and belly, as well as limbs and tail, not wholly deep glossy black; hairs on back black at base, and either black distally or with tips tinged with either burnt umber or seal brown.

**F.** Crown cap tawny-olive, yellowish wood brown, or with black hairs tipped with burnt umber; underparts similar in color to upperparts; entire body, including limbs and tail, covered with black hairs tinged distally with burnt umber; foot small (length, heel to end longest toe, 150–170 mm.); tail variable in length, usually one-fifth or more longer than head and body. (Pacific side of cordillera of Ecuador.)— **fusciceps**

<sup>1</sup> Colors mentioned in this key are shown in Robert Ridgway's "Color Standards and Color Nomenclature," 48 pp., 53 pls. Washington, 1912.



**FF.** Crown cap black, not tawny-olive, yellowish wood brown, or with hairs tipped with burnt umber; underparts conspicuously lighter in color than upperparts, line of demarcation between upperparts and underparts being sharply defined; general coloration of crown cap on head as well as rest of upperparts black; in some individuals these black hairs under strong light having a seal-brown tinge; triangular forehead patch yellow, golden, brownish yellow, or white (occasionally either entirely absent or more or less hidden by anterior stiff black hairs); side whiskers on face, when present, whitish or buffy (not present in some specimens); outer surfaces of forelimbs to elbows black; outer surfaces of forearms to wrists generally blackish but occasionally similar to underparts and intermixed with long dusky overhairs; outer surfaces of hind limbs usually blackish to knees or below, but in some specimens (particularly in eastern part of range) outer surfaces of hind limbs, including thighs and region around base of tail, distinctly straw-colored in ground color overlaid with sparse long black hairs (not numerous enough to affect general ground color); hairs on throat normally black, sometimes grayish, more or less concealed by black hairs; remainder of underparts, inner surfaces of fore and hind limbs, as well as under surface of tail, yellow, cinnamon-buff, dull cream-buff, or pale olive-buff; tail normally bicolored, upper surface being black and under surface similar to that of underparts (in occasional specimens upper surface of tail approximately same as that of under surface but more heavily interspersed with long black overhairs); foot large (length, heel to end longest toe, 190-200 mm.); tail variable in length but often almost twice length of head and body. (From near junction of Río Caura with Río Orinoco in Venezuela south to Río Negro in Brazil, westward to Colombia east of Cordillera Oriental (Mambita), Ecuador east of Andes, and northeastern Peru.) ----- belzebuth

**AA.** General coloration of entire back not chiefly (jet) black.

**G.** A conspicuous white triangular forehead patch; general coloration of upperparts wood brown, darker on head and upper back and lighter on lumbar region and thighs; underparts, inner surfaces of fore and hind limbs, and under surface of tail whitish or buffy; side whiskers on face variable, sometimes whitish or buffy and sometimes dark wood brown. (Magdalena River Valley and adjacent mountains, Colombia.) ----- hybridus

**GG.** No conspicuous white triangular forehead patch; general coloration of upperparts not wood brown.

**H.** General coloration of upperparts, except for head and shoulders on some individuals, tending toward light mahogany red; underside of tail, at least on basal half, deep cinnamon-rufous to ferruginous; back and shoulders grading from dark rusty reddish to ferruginous or burnt sienna, with varying admixture of overlying blackish hairs; underparts similar in color to back but with less noticeable admixture of blackish hairs; face, crown cap on head, and median streak on back of neck blackish; sides of neck covered with a mixture of pinkish-buff, cinnamon-buff, and blackish hairs; outer surfaces of fore and hind limbs either black or blackish to knees and elbows; outer surfaces of limbs below knees and elbows either black or with varying admixture of black and ferruginous hairs; a distinct ferruginous or cinnamon-buff streak along inner surface of arm from armpit to elbow. (Western side of

central cordillera of Costa Rica (Río Pirris) south to Cordillera de San Blas (Cerro Azul) of eastern Panama.)-----panamensis

HH. General coloration of upperparts, except for head and shoulders, not uniform light mahogany red; underside of tail not deep ferruginous.

I. General coloration of upperparts as well as underparts light buff overlaid with dusky tipped hairs; side whiskers on face silky light buff; dark markings on head and limbs usually inconspicuous; crown cap on head grading from black to buff tinged with brownish; stiff long black hairs above eyes concealing to a variable extent the white or buff triangular forehead patch; elbows and outer sides of forearms more or less distinctly blackish; elongate black patches on knees, the hairs black to roots. (Southern Nicaragua, Greytown to Lake Managua.)-----geoffroyi

II. General coloration of upperparts as well as underparts not light buff.

J. Chest and belly normally near tawny or cinnamon-rufous.

K. General coloration of upperparts golden yellowish to cinnamon-rufous in tone but obscured by numerous overlying black-tipped hairs; crown cap black, the hairs black to base; underparts and flanks near tawny or cinnamon-rufous; tail black above, more or less mixed with tawny below from base to near callosity; side whiskers on face blackish. (Eastern side of central cordillera of Costa Rica.)-----ornatus

KK. General coloration of upperparts lighter or duller than preceding.

L. General coloration of upperparts, except for head and shoulders, clear tawny, intermixed with black-tipped hairs; sides, thighs, and belly paler, tawny or cinnamon-buff, with somewhat paler tone extending downward to wrists and ankles on inner surfaces of fore and hind limbs; shoulders and outer surfaces of fore and hind limbs black; tail sharply bicolored, black above to tip, and tawny below; crown cap either black or dusky (individual hairs buff or cinnamon-buff at base); side whiskers on face cream color. (Azüero Peninsula, Panama.)-----azuerensis

LL. General coloration of upperparts, except for head and shoulders in some individuals, buckthorn brown to Mars brown, sparsely or noticeably intermixed with blackish hairs (especially on midline of back in some individuals); belly honey yellow to tawny, extending downward on inner surfaces of hind limbs to ankles, and a lighter tone extending downward on inner surfaces of forelimbs to wrists; outer surfaces of fore and hind limbs usually black (in some individuals restricted more or less to elbow and knee patches); tail usually sharply bicolored, black or dusky above to tip and tawny below (when otherwise, mixed light and dark hairs cover tail above and below); anterior part of crown patch more or less suffused with cinnamon-buff, owing to light basal color of hairs and tending to form a transverse band across forehead; side whiskers on face light buff to cream-buff. (Northwestern Costa Rica and higher portions of northern Nicaragua.)-----frontatus

JJ. Chest and belly normally neither tawny nor ochraceous-rufous.

M. Upper back distinctly darker than lumbar region of back; top of head, neck and upper back, and outer surfaces of fore and hind limbs varying from blackish to brownish black.

- N.** Underparts normally silvery whitish; brownish black of head and neck passing gradually through cinnamon-drab on upper back to near olive-buff on lumbar region, the light drab extending along median line to base of tail; side whiskers on face whitish. (Quintana Roo, Yucatán, and northeastern Guatemala.) ----- *yucatanensis*
- NN.** Underparts not normally silvery whitish.
- O.** Upperparts dark, especially on head, neck, and upper back, and more uniformly overlaid with black; lumbar region more or less noticeably suffused with cinnamon; pelage typically longer and denser; underside of neck and throat mixed brownish and buffy; rest of underparts including at least inner surfaces of upper portions of limbs pinkish buff to cinnamon-buff, becoming cinnamon or rusty along sides of body; crown cap blackish; side whiskers on face blackish. (Alta Vera Paz, Guatemala.) ----- *pan*
- OO.** Upperparts lighter, distinctly bicolored; head, neck, and upper back brownish black; lumbar region cinnamon-buff or cinnamon, darkened along midline by overlying blackish hairs; underside of neck and throat varying from grayish to a mixture of buff-gray and brown; underparts, including inner surfaces of arms in a strip narrowing from armpit to a point near elbows and on inner surfaces of legs to near ankles, varying from pinkish buff to cinnamon, becoming near cinnamon on sides of body; crown cap blackish; side whiskers on face dull whitish or yellowish. (Honduras and El Salvador northward through Guatemala to southeastern Oaxaca and the Isthmus of Tehuantepec and along east coast of Mexico to eastern San Luis Potosí.) ----- *vellerosus*
- MM.** Upper back not distinctly darker than lumbar region of back; general coloration of upperparts, including outer surfaces of fore and hind limbs, as well as upper surface of tail, dusky, the darker hairs nearly sooty black on distal two-thirds and old gold on basal third, and thinly interspersed with these on head, neck, back, thighs, and upper surface of tail are old gold or silvery hairs; coloration of upperparts further modified by lighter hair bases showing through; a partially concealed buffy spot on forehead; hairs on belly, inner surfaces of hind limbs, and under surface of tail dull cinnamon-buff tipped with sooty black. (Río Tuyra Valley of eastern Panama.) ----- *grisescens*

## ATELES PANISCUS PANISCUS (Linnaeus)

## GUIANA BLACK SPIDER MONKEY; LE COAITA

[*Simia*] *paniscus* LINNAEUS, *Systema naturae*, ed. 10, vol. 1, p. 26, 1758.

*Sapajou paniscus* LACEPÈDE, *Tableau des divisions, sous-divisions, ordres et genres des mammifères*, p. 4, 1799. [Published as supplement to *Discours d'ouverture et de clôture du cours d'histoire naturelle, et tableaux méthodique des mammifères et des oiseaux*.]

*Ateles pentadactylus* E. GEOFFROY, *Ann. Mus. Hist. Nat. Paris*, vol. 7, p. 269, 1806. Type locality, Cayenne, French Guiana. (Description based on female collected by Martin.)

*Ateles subpentadactylus* DESMAREST, *Encyclopédie méthodique (Zoologie), Mammalogie*, pt. 1, p. 73, 1820. Type locality, "La Guyane française, la côte de Bancet au Pérou" (part).

*A[teles] ater* F. CUVIER, *Histoire naturelle des mammifères*, vol. 3, livr. 39, p. [1], pl. —, Mar. 1823. Type locality, Cayenne, French Guiana (see I. Geoffroy, 1851, *Catalogue méthodique de la collection des mammifères*, pt. 1 (*Catalogue des Primates*), p. 48). ("Le Cayou" is based on a rather young female.)

[*Cebus paniscus*] *surinamensis* FISCHER, *Synopsis mammalium*, p. 39, 1829. Type locality, not designated.

[*Cebus paniscus*] *cayennensis* FISCHER, *Synopsis mammalium*, p. 39, 1829. Type locality, "Guyana Gallica."

*Type locality*.—"South America: Brazil" ["La Guyane" given as the "Patrie" by E. Geoffroy, *Catalogue Mammifères Mus. Nat. Hist. Nat. Paris*, p. 6, 1803. Here restricted to French Guiana.]

*Type specimen*.—Unknown.

*Distribution*.—North side of Amazon River east of Manáos and north to Caribbean coast of the Guianas.

*General characters*.—A black monkey with face normally flesh-colored; pelage silky, lax, and very long (majority of hairs on midline of back 75–150 mm. in length, and on upper basal half of tail 50–100 mm. in length); hind foot large (190–220 mm.); tail often more than twice length of head and body. Differs from *chamek* of Peru mainly in normally flesh-colored instead of normally black face and in longer pelage (majority of hairs on midline of back less than 75 mm. in length and on upper base of tail less than 50 mm. in length in *chamek*). Differs from *A. belzebut* *belzebut* of Venezuela in much longer pelage and nearly uniform black instead of contrasting colors of upper and underparts. Differs from *A. belzebut* *marginatus* of the Rio Tapajóz region of the southern side of the Rio Amazonas, Brazil, in longer pelage, larger foot, and lack of the semilunar white forehead patch present in *marginatus*.

*Color*.—Entire pelage deep glossy black; face normally flesh-colored.

*Skull*.—Skull large, with anterior profile strongly inclined backward to vault of brain case; premaxillae, when viewed from above, relatively broad; nasal opening much elongated. Very similar to skulls of *chamek* and *belzebut*, but brain case somewhat less highly arched than either; rostrum broader, the sides more inflated at base and

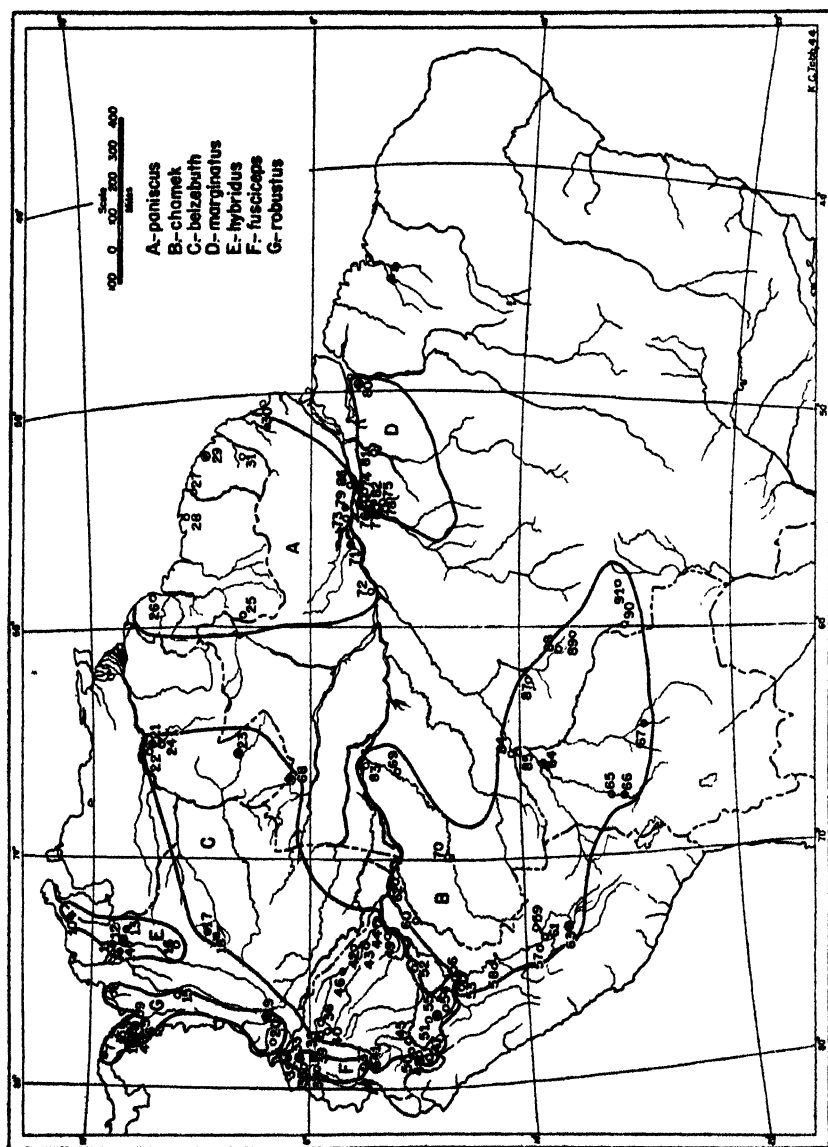
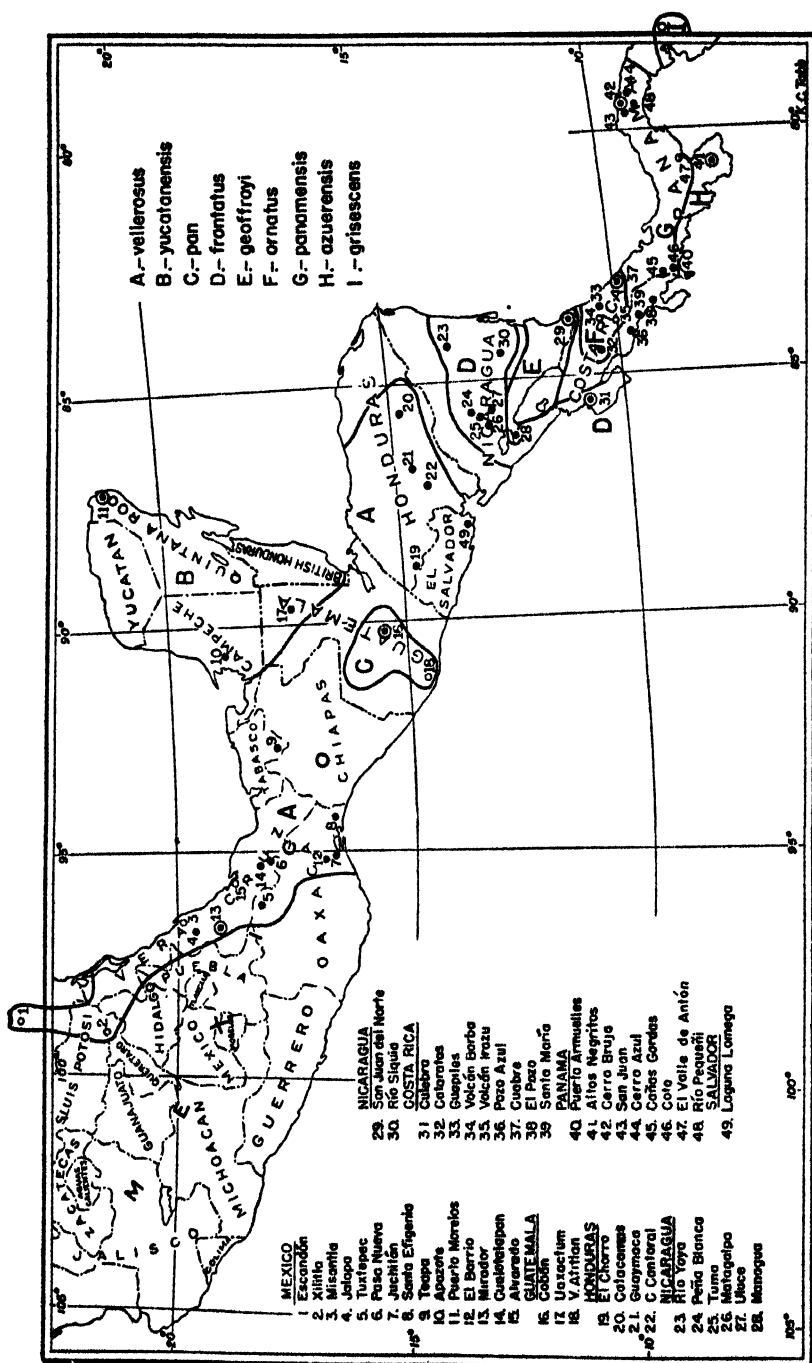


FIGURE 1.—Distribution of the forms of spider monkeys (*Atelax*) in South America. See opposite page for key to loca



FIGURE 2.—Distribution of the forms of spider monkeys (*Atelus*) in Middle America.

sloping outward more gradually to zygomata; maxillae forming a more distinct ridge behind posterior molars; thin external reduplications of pterygoids extending farther posteriorly, the posterior borders less deeply concave behind the internal spinelike hamular processes; posterior plane of posterior upper molars barely reaching anterior plane of temporal fossae.

*Measurements.*—Two adult females from Rio Jamundá, near Faro, north bank of Rio Amazonas, Pará, Brazil, respectively: Total length, 1,330, 1,339 mm.; tail, 870, 920; hind foot, 195, 195. Two adult females from Lago Cuipeúá, north bank of Rio Amazonas, Pará, Brazil, respectively: Total length, 1,450, 1,413; tail, 880, 753; hind foot, 220, 220. *Skull:* Two adult females from Rio Jamundá, near Faro, Brazil, respectively: Greatest length, 118.8, 116.8; orbital width, 68.3, 63.6; post-orbital constriction, 48.8, 51.3; width of brain case, 64, 63.3; zygomatic width, 68.7, 66.7; maxillary tooth row, 29.9, 29.5. Two adult females from Lago Cuipeúá, Brazil, respectively: Greatest length, 113.6, 122.6; orbital width, 60.2, 68.2; postorbital constriction, 51.4, 51.4; width of brain case, 64.5, 64.6; zygomatic width, 69.4, 70.5; maxillary tooth row, 29.9, 29.5.

*Remarks.*—Linnaeus, in the tenth edition of *Systema Naturae* (vol. 1, p. 26, 1758) combined the previously published descriptions of a spider monkey and of a howler monkey in formulating his diagnosis of [*Simia*] *paniscus*. The spider monkey is described in the following words: "*Simia fusca major, palmis tetradactylis, cauda prehensili ad apicem subtus nuda*," and this is a word-for-word quotation from the account of the "four-fingered monkey" published by Browne (*The civil and natural history of Jamaica*, p. 489, 1789; edition of 1756 not consulted). The longer diagnosis at the end of Linnaeus's account of *paniscus* seems to be based mainly on the accounts of the "Guariba" published by Marcgrave (*Historiae rerum naturalium*, p. 226, 1648; and *Historia natural do Brasil*, p. 226, 1942) and by Ray (*Synopsis methodica animalium quadrupedum et serpentine generis*, p. 153, 1693), supplemented by additional anatomical details which are credited to Hallman and Aymen.

In the twelfth edition, however, Linnaeus (*Systema naturae*, ed. 12, vol. 1, p. 37, 1766) seems to have recognized that the above-mentioned combination was inaccurate, and of the tenth edition references he cited only that of Browne (*op. cit.*, 1756, p. 489) in the synonymy of [*Simia*] *paniscus*. With the exception of "*Pedes & Cauda dimidia exterior brunnea*," this revised diagnosis applied to the "coaita." Furthermore, in the twelfth edition Linnaeus (*op. cit.*, p. 37, 1766) placed the references to Marcgrave and Ray, which had been cited under *paniscus* in the tenth edition, in the synonymy of the howler monkey, [*Simia*] *belzebul*. We are therefore of the opinion that Linnaeus in



1766 should be regarded as the first reviser and that the references to Marcgrave and Ray should definitely be eliminated in reaching a conclusion concerning the status of *paniscus*.

The "Guariba" of both Marcgrave and Ray is unquestionably the howler monkey, as was recognized by both Pennant (Synopsis of quadrupeds, p. 122, 1771; "preacher") and Goldfuss (Schreber, Die Säugthiere, Theil 1, Heft 7, p. 112, 1774). The bases and type localities of the mammalian species in the tenth edition of Linnaeus were construed as they were by Thomas (Proc. Zool. Soc. London for 1911, pt. 1, p. 127, Mar. 22, 1911) on the assumption that Linnaeus's "quotation of his own earlier writings should be given absolutely overriding importance" and that all others should be ignored. The Linnean quotation under [*Simia*] *paniscus* in the tenth edition is "*S. caudata barbata, cauda prehensili, palmis subtetradactylis*. Syst. nat. 3," and on referring to the sixth edition of Systema Naturae (p. 3, 1748), it will be noted that Linnaeus altered his original concept of this species by adding "*palmis subtetradactylis*," since the diagnosis under "*Simia*" in the earlier edition reads "14. *Simia caudata barbata, cauda prehensili*. Marcgr. bras. 226." On the assumption that the reference to Marcgrave was the primary reference, Thomas designated Pernambuco as the type locality for *paniscus*. In view of the fact that Marcgrave's account of the "Guariba" applies solely to the howler monkey, the designation of Pernambuco as the type locality for *paniscus* cannot be accepted. Browne (*op. cit.*, p. 489, 1789) stated that the "four-fingered monkey" is an inhabitant of the main continent, Linnaeus in the tenth edition gave the habitat of *paniscus* as "*America meridionali: Brasilia*," and in the twelfth edition after the removal of the references to the "Guariba" Linnaeus restricted the habitat to "*America meridionali*." Since "*La Guyane*" has been designated by Geoffroy (*op. cit.*, p. 6, 1803) as the "*patrie*" of *paniscus*, we hereby restrict the type locality to French Guiana.

The Guiana black spider monkey is readily distinguished from all others by its long, lax, silky pelage and its large foot. It is believed to be restricted to the area between the north bank of the Amazon River and the coast of the Guianas. It was met with by various early travelers, and several names proposed seem clearly to belong in synonymy. In the three specimens from Rio Jamundá, on the north bank of the Amazon, near Faro, Brazil, vestigial thumbs are present as pointed out by Tate (Bull. Amer. Mus. Nat. Hist., vol. 76, p. 215, Oct. 20, 1939). In two from Lago Cuipeté, also on the north bank of the Amazon, farther to the east, vestigial thumbs are present in the skeleton, as usual in the group, but do not appear to have been discernible in the skin. Tate (*op. cit.*) refers to "small, triangular pterygoids without pointed tips" as a cranial character in *paniscus*. The external reduplications of the pterygoids are broken off in the

specimens examined by Tate, but the thin pterygoid plates in these and in other specimens from that region are in reality larger and more extended posteriorly than usual in spider monkeys. Other characters ascribed by him to *paniscus* are the small postglenoid processes and unexpanded zygomata of nearly uniform depth. Examination of large series of spider monkey skulls shows that these cranial features are everywhere subject to about the same wide range of individual variation.

In Dutch Guiana, Kappler (Popular Sci. Monthly, vol. 32, No. 3, pp. 397–398, Jan. 1888) states that this monkey does not occur on the coast and that it is found only in the higher lands. An adult male collected by Kappler along the Marowijne River [=Río Maroni], Dutch Guiana, is listed by Jentink (Catalogue systématique des mammifères, Mus. Hist. Nat. Pays-Bas, vol. 11, p. 41, 1892). Thomas (Ann. Mag. Nat. Hist., ser. 8, vol. 6, p. 505, Nov. 1910), however, records this monkey from the River Supinaam, lower Essequibo, Demerara, British Guiana. Richard Schomburgk (in Roth, Richard Schomburgk's travels in British Guiana 1840–1844, vol. 2, p. 72, 1923), states that this monkey is found mostly in troupes of 16 to 20 in the highest trees and that one was killed in the vicinity of Maripá at the forks of the upper Río Waku-wau, a tributary of the Río Tacutú, south of the Kanuku Mountains, British Guiana.

In French Guiana, Ménégaux (Bull. Mus. Hist. Nat. Paris, vol. 8, No. 5, p. 296, 1902) has recorded this spider monkey from the Rivière Camopi, a tributary of the Río Oyapock, and from the Río Lunier, a tributary of the Río Carsevenne [=Calsoene].

Lönnerberg (Arkiv för Zool., vol. 32A, No. 25, p. 8, July 18, 1940) has recorded specimens from the Igarapé [=Rio] Anibá, north bank of Rio Amazonas opposite mouth of Rio Madeira, and from Patuá (or Paitaná), Pará, Brazil.

*Specimens examined*.—Total number, 5, as follows: BRAZIL: Lago Cuipeúa, north bank Rio Amazonas, Pará, 2 (M. C. Z.); Rio Jamundá near Faro, north bank of Rio Amazonas, Pará, 3 (A. M. N. H.).

#### ATELES PANISCUS CHAMEK (Humboldt)

#### BLACK-FACED BLACK SPIDER MONKEY

*Simia chamek* HUMBERT, Recueil d'observations de zoologie et d'anatomie comparée, vol. 1, p. 853, 1812.

*Ateles longimembris* J. A. ALLEN, Bull. Amer. Mus. Nat. Hist., vol. 33, p. 651, Dec. 14, 1914. Type locality, Barrão de Melgaço, headwaters of Rio Gy-Paraná, Matto Grosso, Brazil.

[*Ateles ater*] *peruvianus* LÖNNERBERG, Arkiv för Zool., vol. 32A, No. 25, p. 13, July 18, 1940. Type locality, eastern Peru.

*Type locality*.—Peru. [Here restricted to Río Comerciato, a tributary of Río Urubamba, Cuzco, Peru.]

*Type specimen*.—Unknown.

*Distribution*.—Western Matto Grosso, eastern Bolivia, and north-eastern Peru to the Rio Solimões and Rio Juruá, Amazonas, Brazil.

*General characters*.—Entirely black, with pelage of moderate length, the hairs on midline of back 75 mm. or less, and on upperside of tail 40–65 mm. Similar in general to *paniscus* of French Guiana, but face black instead of flesh color; pelage shorter, the majority of hairs on midline of back 75 mm. or less, instead of 75 to 150; tail often more than twice length of head and body and hind foot large as in *paniscus*; skull differs from that of *paniscus* in detail. Similar in color to *A. fusciceps robustus* of southeastern Colombia, but pelage entirely black without the short, sparse white hairs on chin and about the mouth of the latter that while inconspicuous appear to be important as a distinguishing character; cranial details also different. Differs from *A. belzebuti belzebuti* of Venezuela in uniform black instead of contrasting black and buffy upper and underparts.

*Color*.—Epidermis of face normally black and entire pelage deep, glossy black.

*Skull*.—Similar in size to that of *paniscus*, but brain case slightly more highly arched; rostrum narrower, less inflated at base and sloping outward more abruptly to zygomata; premaxillae more distinctly pinched-in behind incisors, the sides being almost parallel; maxillae more truncate instead of prolonged in a distinct ridge behind posterior molars; external reduplications of pterygoids less extended posteriorly, the posterior borders more deeply concave; palate narrower; posterior plane of last molars reaching farther posteriorly into anterior plane of temporal fossae. Differs from that of *robustus* as follows: Premaxillae more extended anteriorly beyond canines, the sides more constricted and more nearly parallel at diastema between incisors and canines; nasal opening more elongated. Compared with that of *belzebuti* the skull is very similar in general, but the premaxillae differ in narrowness in about the same way as from *robustus*.

*Measurements*.—An adult male and female from Río Comerciato, Peru, respectively: Total length, 1,270, 1,380 mm.; tail, 820, 880; hind foot, 190, 202. Two adult females from Río Yapacani, Bolivia, respectively: Total length, 1,320, 1,320; tail, 800, 800; hind foot, 220, 220. *Skull*: Adult male and female from Río Comerciato, respectively: Greatest length, 117.5, 117; orbital width, 48.9, 50.8; width of brain case, 64.7, 59.8; zygomatic breadth, 68, 67.8; maxillary tooth row, 33, 29. Two adult females from Río Yapacani, respectively: Greatest length, 121.1, 118.8; orbital width, 63.8, 59.2; postorbital constriction, 50.1, 48.7; width of brain case, 65.4, 64.7; zygomatic breadth, 71.3, 68.2; maxillary tooth row, 31.4, 31.5.

*Remarks*.—The large black spider monkey here treated as *A. paniscus chamek* appears to be distinguished as the most completely black

form in the group. It agrees closely in large size with *paniscus* but differs in having black instead of flesh-colored face, shorter pelage, and cranial details pointed out. The general resemblance of *chamek* to *A. fusciceps robustus* of Colombia is very close, but the short white hairs on the chin and about the mouth, together with the smaller foot of the latter, are distinctive.

Specimens collected by Johann Natterer in 1825 on the Rio Sararé while en route from Matto Grosso (Villa Bella de Santissima Trinitade) to São Vicente and in 1829 on the Rio Madeira above the mouth of the Rio Abuña probably are referable to this race (Wagner, Abh. math.-phys. Cl. bayer. Akad. Wiss. München, vol. 5, Abt. 2, p. 418, 1848). Similarly the specimens described by Miranda Ribeiro (Comissão de Linhas Telegraphicas Estrategicas de Matto Grosso ao Amazonas, Anexo No. 5, Hist. Nat., Zool., Mammiferos, p. 8, May 1914) from Cabeceiras do Pirocoluina and Jarú on Rio Juruá, a tributary of the Gy-Paraná, are likewise referred to this race. This spider monkey is reported to occur also in the Serra dos Parecis in central Matto Grosso. The specimens mentioned by Lönnberg (Arkiv för Zool., vol. 32A, No. 25, p. 10, July 18, 1940) from Puerto Salinas and Desierto on the Río Beni, Bolivia, may belong here since three specimens (C. M. Nos. 2772, 2774, 2775) taken by José Steinbach on the Río Yapacani, a tributary of the Río Mamoré, seem referable to this form.

Under the name of *Ateles ater* [= *paniscus*], Thomas (Ann. Mag. Nat. Hist., ser. 10, vol. 2, p. 251, Sept. 1928) listed specimens from Cerro Azul, altitude 2,000 feet about 35 miles west of Río Ucayali, and from Chicosa, upper Río Ucayali, Peru, about 35 miles below junction of Urugamba and Tambo Rivers, altitude 1,500 feet. A similar allocation has been made by Thomas (Proc. U. S. Nat. Mus., vol. 58, p. 220, Nov. 10, 1920) of specimens (U. S. N. M. Nos. 194337-38 and -40) from Río Comerciato, a tributary of Río Urubamba, Cuzco, Peru, altitude 3,000 feet, and from Pachitea.

According to Bartlett (Proc. Zool. Soc. London for 1871, pt. 1, p. 218, June 1871) the black-faced spider monkey inhabits the forests on the Río Ucayali and the low districts of the valley of the Amazonas in Peru. A specimen from Peruaté on Río Marañón is recorded by Cabrera (Trabajos Mus. Nat. Cienc. Nat. Madrid, ser. zool., No. 31, p. 46, Oct. 28, 1917). A female obtained by Castelnau and Deville on the banks of the Río Javari near its mouth on the Río Amazonas is listed by I. Geoffroy (Catalogue méthodique de la collection des mammifères, pt. 1 (Catalogue des Primates), p. 48, 1851).

It is possible that this black-faced spider monkey may range down the Río Marañón and the Solimões to the Rio Juruá in Brazil since Lönnberg (Arkiv för Zool., vol. 32A, No. 25, p. 10, July 18, 1940) lists as *ater* specimens from Lago Grande west of mouth of Rio Juruá on Rio Solimões, from Jaburú and João Pessoa on the lower Rio Juruá

and from Santo Antonio on the Rio Eirú, a tributary of the upper Rio Juruá. The specimens described by Von Ihering (Rev. Mus. Paulista, vol. 6, p. 409, 1904) from below São Felipe on the Rio Juruá should belong to the same race.

Although Wallace (Proc. Zool. Soc. London for 1852, pt. 20, p. 108, May 23, 1854) remarks that another spider monkey, "probably *Ateles ater*, inhabits the West Brazil district on the river Purus," recent work in Brazil has not confirmed this statement.

*Specimens examined.*—Total number, 9, as follows: BOLIVIA: Ibon [=Ivon], Río Beni, 1; Río Yapacani, 4 (1 skull only; C. M.); Santa Helena (upstream from Rurrenagaque), Río Beni, La Paz, 1. PERU: Río Comerciato, a tributary of Río Urubamba, Cuzco, 3.

#### ATELES BELZEBUTH BELZEBUTH E. Geoffroy

##### MARIMONDA SPIDER MONKEY

*Ateles belzebuth* E. GEOFFROY, Ann. Mus. Hist. Nat., Paris, vol. 7, p. 272, pl. 16, 1806.

*Le chuva de Bracamorros* HUMBOLDT, Recueil d'observations de zoologie et d'anatomie comparée, vol. 1, p. 8, 1812; "*Ateles marginatus*," p. 341 (Province de Jaén de Bracamoros, on the banks of Río Santiago and Río Amazonas [=Río Marañón] between the cataracts of Yariquisá and of Patourumi, Departamento de Amazonas, northern Peru; specimen brought by Indians from Tutumbero, opposite Pongo de Cacangares, seen in house of governor at Tomependa, on Río Marañón near mouth of Río Chinchipe.)  
A[teles] *marimonda* OKEN, Lehrbuch der Naturgeschichte, Theil 3, Zool., Abt. 2, p. 1201, 1816. Type locality, Orinoco.

*Ateles fuliginosus* KUHL, Beiträge zur Zoologie und vergleichenden Anatomie, Abth. 1, p. 25, 1820. Type locality, unknown. [Based on specimen in Mus. Nat. Hist. Nat. Paris.]

*Cebus brissonii* FISCHER, Synopsis mammalium, p. 40, 1829. Type locality, Río Orinoco, Venezuela.

A[teles] *variegatus* WAGNER, Schreber's Die Säugethiere, Suppl., Abt. 1, p. 313, 1840. Type locality, Cocuy [=Cucul or Cucuhy], Río Negro, northern Amazonas, Brazil, at the Venezuelan boundary (*vide* Wagner, 1847, Abh. math.-phys. Cl. bayer. Akad. Wiss. München, vol. 5, Abth. 1, p. 421) = Serra de Cocoi, upper Río Negro (*vide* Selater, Ann. Mag. Nat. Hist., ser. 4, vol. 6, p. 472, Dec. 1870). (Preoccupied by *Simia variegatus* Kerr, 1792 = *Ateles variegatus* (Kerr), unidentifiable.)

*Ateles bartlettii* GRAY, Ann. Mag. Nat. Hist., ser. 3, vol. 20, No. 118, p. 300, Oct. 1867. Type locality, Brazil, the upper part of the Amazons ["Eastern Perú, near Xeberos" = Jeberos or Jeveros, Loreto (see Gray, Proc. Zool. Soc. London for 1867, pt. 3, No. 63, p. 992, pl. 47, Apr. 1868) = Forests of northwestern Perú at highest point of mountains on forest trail between Moyobamba and Chayavitos, three days' journey from the latter (see Bartlett, Proc. Zool. Soc. London for 1871, pt. 1, No. 14, p. 217, June 1871).]

*Ateles chuva* SCHLEGEL, Mus. Hist. Nat. Pays-Bas, vol. 7, livr. 12 (Monogr. 40: Simlae), p. 175, 1876. Type locality, not designated. [Based in part on "*Le chuva de Bracamorros*" of Humboldt, 1812; *Ateles variegatus* of Wagner, 1840; *Ateles bartlettii* of Gray, 1868; and two mounted female specimens, one from Peru, in the Leiden Museum.]

*Ateles problema* SCHLEGEL MS., in Jentink, Catalogue systématique des mammifères, Mus. Hist. Nat. Pays-Bas, Leiden, vol. 11, p. 42, 1892 (*nomen nudum*).

*Type locality*.—Unknown. [Here restricted to Esmeralda, west of the mouth of Río Guapo, on Río Orinoco, and south of Mount Duida, Venezuela (see Humboldt, Recueil d'observations de zoologie et d'anatomie comparée, vol. 1, livr. 7, p. 326, 1812).]

*Type specimen*.—A specimen exhibited at public fairs until after its death, when it passed into the possession of Réaumer, constituted the basis of "Le Belzebut" of Brisson (*Regnum animale*, p. 211, 1756); this stuffed specimen, the description of Buffon, and two living spider monkeys in the menagerie were combined as the basis for Geoffroy's name.

*Distribution*.—Ranges in the vast lowlands from near the junction of the Río Orinoco and Río Caura in central Venezuela south to the valley of the Rio Negro, westward to Colombia east of the Cordillera Oriental (Mambita), Ecuador east of the crest of the Andes, and to northeastern Peru (Sarayacu).

*General characters*.—Distinguished by unusual color pattern, the black upperparts contrasting strongly with pale buffy underparts, there being a sharp line of demarcation along lower part of sides. This marked contrast in coloration extends to the outer and inner surfaces of its limbs, although these vary in detail, and a triangular forehead patch varying from white to golden or brownish yellow is normally but not invariably present. Foot large (190–200 mm.); tail variable in length but often almost twice the length of head and body. Differs conspicuously in color, but similarity in cranial details indicates close relationship to *hybridus* of Colombia. Differs notably from *A. paniscus paniscus* of French Guiana in much shorter pelage and in contrasting colors of upper parts and underparts.

*Color*.—Face and eyebrows black, a triangular forehead patch varying from white to golden, yellow, or brownish yellow (occasionally entirely absent or more or less hidden by stiff upturned black hairs over eyes and opposing black frontal tuft from crown); crown cap and upperparts generally black to a sharp line of demarcation with underparts (in some individuals the black hairs under strong light have a seal-brown tinge); underparts, in general, including inner surfaces of fore and hind limbs, and underside of tail varying from cinnamon-buff, yellow, or dull cream-buff to pale olive-buff; side whiskers on face, when present, whitish or buffy (absent in some specimens); outer surfaces of forelimbs to elbows black; outer surfaces of forearms to wrists generally blackish, but occasionally similar to underparts and intermixed with long dusky overhairs. Outer surfaces of hind limbs usually blackish to knees or below, but in some specimens (particularly in eastern part of range) the outer surfaces of hind limbs, as well as thighs and region around base of tail, are distinctly straw-colored in

ground color thinly overlaid with long black hairs (not numerous enough to materially affect the general ground color); hairs on throat normally black, sometimes grayish, more or less concealed by black hairs; tail normally bicolored, the upper surface black and the under surface similar to that of underparts (in occasional specimens the upper surface is about the same as that of the under surface, but more heavily interspersed with long black overhairs).

*Skull*.—About as in that of *hybridus*. Very similar in general to that of *paniscus* but brain case somewhat narrower; posterior borders of external reduplications of pterygoids more deeply concave.

*Measurements*.—An adult male and female from El Llagual, Caura District, Venezuela, respectively: Total length, 1,257, 1,317 mm.; tail, 823, 810; hind foot, —, 193. An adult male and female from Valle de los Monos, Mount Duida, Venezuela, respectively: Total length, 1,110, 1,330; tail, 695, 840; hind foot, 185, 195. *Skull*: An adult male and female from El Llagual, Venezuela, respectively: Greatest length, 109.5, 117.7; orbital width, 60.2, 61.8; postorbital constriction, 50, 51; width of brain case, 59.7, 59.8; zygomatic width, 68.3, 66.7; maxillary tooth row, 29.8, 28.8. An adult male and female from Valle de los Monos, Venezuela, respectively: Greatest length, 119.4, 113.2; orbital width, 61.6, 61; postorbital constriction, 52, 52.1; width of brain case, 61, 63.2; zygomatic width, 71.9, 68.4; maxillary tooth row, 29.9, 30.

*Remarks*.—This well-marked and widely dispersed spider monkey has evidently been described under various names which appear to be assignable to the synonymy of *belzebuth*. Humboldt (Recueil d'observations de zoologie et d'anatomie comparée, vol. 1, livr. 7, p. 353, 1812) observed that it was found along the banks of the Río Orinoco but always above the Raudal de Atures and the Raudal de Maipures in Venezuela. Allen records specimens from La Unión on the Río Caura (Bull. Amer. Mus. Nat. Hist., vol. 20, No. 29, p. 344, Oct. 8, 1904) as well as from the Río Mato, a tributary of the Río Caura (Bull. Amer. Mus. Nat. Hist., vol. 28, No. 12, p. 148, May 27, 1910) and from El Llagual on the Río Caura, Venezuela (Bull. Amer. Mus. Nat. Hist., vol. 30, No. 10, p. 272, Dec. 2, 1911). Johann Natterer in February 1831 obtained a male, three females, and a young of this spider monkey at Serra de Cocoi on the upper Río Negro, Brazil, one female of which was exchanged with the British Museum of Natural History (Sclater, Proc. Zool. Soc. London for 1871, pp. 39, 225, 1871).

According to Bartlett (Proc. Zool. Soc. London for 1871, p. 217), this spider monkey is found in Peru in the interior forest on the mountain range between Lamas (north of Río Mayo, a tributary of Río Hualaga) and Saravacu on Río Ucayali; on the lower spurs of the mountains between Moyobamba and the Río Huallaga; at Cahuapanas on the headwaters of the Río Cahuapanas, a tributary of the Río Marañón; near the native village of Chamicuros (Parinari District) on

the Río Chamicuros [=Río Samiria], a tributary of the Río Marañón; and on the Río Tigre, a northern tributary of the Río Marañón west of Nauta. It has been reported also from Puerto Indiana on the Río Marañón just west of mouth of the Río Napo by Tate (Bull. Amer. Mus. Nat. Hist., vol. 76, p. 216, Oct. 20, 1939), and from Elvira on the Río Marañón above the mouth of the Río Chambira by Bartlett (Proc. Zool. Soc. London for 1882, p. 373).

Specimens are also listed by Goeldi and Hagmann (Bol. Mus. Goeldi, vol. 4, p. 42, 1904) from Iquitos, on the Río Marañón above mouth of the Río Napo, by Cabrera (Trabajos Mus. Nat. Cienc. Nat. Madrid, ser. zool., No. 31, p. 46, Oct. 28, 1917) from Tarapoto (Nueva Florencia) on the Río Napo, and by Lönnberg (Arkiv för Zool., vol. 14, No. 4, p. 6, June 7, 1921) from below Baeza on the Río Quijos, a tributary of the Río Coca in eastern Ecuador. Festa (Boll. Mus. Zool. ed Anat. Comp. Univ. Torino, vol. 18, No. 435, p. 4, Feb. 11, 1903) identifies as *Ateles variegatus* several specimens collected by him in Ecuador in the valley of the Río Santiago and at San José on the Río Suni and remarks that he had found this spider monkey to be abundant in the forests bordering the Paute, Zamora, and Santiago Rivers.

A specimen of this monkey (U. S. N. M. No. 3332) collected by William E. Moore in 1857 somewhere along the Río Napo in eastern Ecuador has yellowish underparts and a golden brow patch.

*Specimens examined*.—Total number, 9, as follows: COLOMBIA: Mambita (Llanos) on Río Guavio, a tributary of Río Meta, 1 (M. C. Z.); Villavicencio, western Río Meta, 1. ECUADOR: Río Napo, 1; Jima (southwest of Sigsig) on headwaters of Río Pamar, a tributary of Río Paute, 1 (skull only, M. C. Z.). PERU: No definite locality, 1 (U. M. M. Z.). VENEZUELA: El Llagual [=Yagual], 2 (A. M. N. H.); Valle de los Monos, Mount Duida, 2 (A. M. N. H.).

#### ATELES BELZEBUTH MARGINATUS E. Geoffroy

##### WHITE-WHISKERED SPIDER MONKEY

*Ateles marginatus* E. GEOFFROY, Ann. Mus. Hist. Nat. Paris, vol. 13, p. 92, pl. 10, Mar. 1809.

*Ateles frontalis* BENNETT, Proc. Zool. Soc. London for 1830-31, pt. 1, No. 4, p. 38, Apr. 6, 1831. Type locality, unknown.

*Ateles albitrons* H. SCHINZ, Systematisches Verzeichniss aller bis jetzt bekannten Säugethiere oder Synopsis Mammalium, vol. 1, p. 68, 1844. [This name appears in the synonymy of *Ateles marginatus* and apparently is based on Coaita à front blanc, *Ateles marginatus* Fr. Cuvier, Histoire naturelle des mammifères, vol. 7, livr. 62, pages unnumbered, Apr. 1830.]

*Type locality*.—"Les parties du Brésil, arrosées par le Rio-Janeiro" [=Pará, Brazil, and the borders of the Río Orinoco, Venezuela; see E. Geoffroy, Ann. Mus. Hist. Nat. Paris, vol. 19, p. 106, 1812. Here restricted to Cametá, Rio Tocantins, Pará, Brazil.]

*Type specimen*.—Muséum National d'Histoire Naturelle, Paris.



*Distribution*.—South side of Rio Amazonas, between the Rio Tapajóz and Rio Tocantins, state of Pará, Brazil.

*General characters*.—A deep, glossy-black spider monkey, with a white semilunar forehead patch and a few white side whiskers on face. Similar in general to *belzebuth*, which it resembles in the possession of a conspicuous forehead patch, but the pelage is longer (longest hairs on back about 90 instead of 50 mm.) and it differs notably in the extension of black over entire body and limbs. Differs from *paniscus* of the opposite side of the Rio Amazonas in smaller size, especially the smaller foot, shorter pelage, and in the conspicuous white forehead patch (absent in *paniscus*); cranial details also different.

*Color*.—An adult male from Caxiricatuba, east bank of Rio Tapajóz, Pará, Brazil: Face flesh-colored, at least around eyes and on nose; side whiskers white mixed with black; a narrow strip across brow just above eyes thinly clothed with erect black hairs behind which is a white semilunar forehead patch overlapped behind by black hairs from crown; rest of upper and underparts deep, glossy black.

*Skull*.—Very similar to that of *belzebuth* but interorbital region more depressed. Compared with that of *paniscus* the interorbital region is more depressed and the anterior profile rises more steeply to vault of brain case; it also differs notably in the lesser posterior extension of the external reduplications of the pterygoids and the smaller winglike tips.

*Measurements*.—An adult male from Caxiricatuba, east bank of Rio Tapajóz, Pará, Brazil: Total length, 1,250 mm.; tail, 750; hind foot, 108 (188 ?). Three females from Marai, right bank of Rio Tapajóz as stated by Lönnberg (Arkiv för Zool., vol. 32A, No. 25, p. 7, July 18, 1940), respectively: Total length, 1,114, 1,190, 1,245; tail, 770, 613, 740; hind foot, 190, 189, 190. *Skull*: Adult male from Caxiricatuba, Rio Tapajóz, Pará, Brazil: Greatest length, 114.1; orbital width, 61.3; postorbital constriction, 49.5; width of brain case, 59.6; zygomatic breadth, 69.7; maxillary tooth row, 31.9.

*Remarks*.—*A. b. marginatus* is readily distinguished by the white semilunar forehead patch combined with black general coloration. It appears to be most closely allied to *belzebuth* but differs in color pattern and in longer pelage. In length of pelage it suggests *paniscus*, which inhabits the opposite bank of the Rio Amazonas, but is less extreme, as the longer hairs on the middle of the back in that form exceed 100 mm. in length. In cranial characters also it agrees more closely with *belzebuth* than *paniscus*.

This black spider monkey with white semilunar patch on forehead and white side whiskers seems to be most abundant between the Rio Tapajóz and the Rio Xingú. Specimens in the Museu Goeldi at Belém were obtained at Altamira on the Rio Xingú and at Santarém at the mouth of the Rio Tapajóz. Lönnberg (Arkiv för Zool., vol. 32A,

No. 25, p. 7, July 18, 1940) records this monkey from Marai on the right bank of the Rio Tapajóz, and Bates (The naturalist on the river Amazona, p. 217, 1875) found it at Aracú on the Rio Cupary, a tributary of the Rio Tapajóz. It was found by Sieber at Cametá on the left bank of Rio Tocantins.

*Specimens examined*.—Total number, 3, as follows: BRAZIL: Caxiricatuba, east bank of Rio Tapajóz, a few miles below Tauary, Pará, 1 (M. C. Z.); no definite locality, 2 (1, C. M.).

#### ATELES BELZEBUTH HYBRIDUS I. Geoffroy

##### HYBRID SPIDER MONKEY

*Ateles hybridus* I. GEOFFROY, Mém. Mus. Hist. Nat. Paris, vol. 17, p. 168, 1829.

*Ateles albifrons* GRAY, Catalogue of monkeys, lemurs and fruit-eating bats in the collection of the British Museum, p. 44, 1870. Type locality, South America.

[*Ateles belzebuth*] *brunneus* GRAY, Catalogue of monkeys, lemurs and fruit-eating bats in the collection of the British Museum, p. 44, 1870. Type locality, "Brazil."

*Amer-anthropoides loysi* MONTANDON, Comptes Rendus Acad. Sci., Paris, vol. 188, No. 11, p. 817, Mar. 11, 1929. Type locality, left affluent of upper Río Tarra, a tributary of the Río Catatumbo, which flows into Lake Maracaibo, Venezuela.

*Type locality*.—Valley of Río Magdalena, Colombia. Here restricted to La Gloria on the Río Magdalena, southern Magdalena Department, Colombia.

*Type specimen*.—Cotypes, 2 males and 1 female, Muséum National d'Histoire Naturelle, Paris; presented by M. Plée in 1826.

*Distribution*.—Serranía de Valledupar (Las Marimondas) and southward along the Río César to the Río Magdalena (Puerto Estrella), and south in the Cordillera Oriental at least to latitude 6° N. in Santander (Bolívar), Colombia.

*General characters*.—Distinguished by wood-brown general coloration of upperparts and a white triangular forehead patch. Apparently closely allied to *belzebuth* of Venezuela, but contrasting strongly in brownish instead of black upperparts. Differs from its geographic neighbor, *A. fusciceps robustus*, of western Colombia, in brownish upperparts and white forehead patch instead of nearly all black coloration, larger foot, and cranial details.

*Color*.—Face and upturned hairs on anterior part of forehead just above eyes black, partially concealing a white triangular forehead patch; coloration of upperparts in general wood brown, darker on head and upper back, becoming lighter and near avellaneous on lumbar region and hips; outer surfaces of forelimbs, thighs, and upperside of tail wood brown; underparts, inner surfaces of fore and hind limbs, and under surface of tail whitish or buffy; side whiskers on face varying from whitish or buffy to dark wood brown.

*Skull*.—About as in *belzebuth*. Similar to that of *A. paniscus paniscus* but variable, the premaxillae in some individuals less produced

anteriorly and the nasal opening less elongated. Compared with that of *A. fusciceps robustus* the premaxillae tend to be more produced anteriorly beyond plane of canines and the nasal opening more elongated.

*Measurements*.—Three adult males from Río Guaimaral, Valledupar, Magdalena, Colombia, respectively: Total length, 1,248, 1,238, 1,211 mm.; tail vertebrae, 750, 739, 741; hind foot, 177, 178, 172. Three adult females from same locality, respectively: Total length, 1,330, 1,247, 1,257; tail vertebrae, 856, 778, 809; hind foot, 185, 187, 187. *Skull*: Three adult males already mentioned, respectively: Greatest length, 113.9, 114.4, 116.6; orbital width, 60, 65, 63.3; postorbital constriction, 50.9, 49.2, 49.4; width of brain case, 65.6, 59.7, 65.3; zygomatic breadth, 71.4, 728, 74.1; maxillary tooth row, 30.3, 30.9, 33.3. Three adult females already mentioned, respectively: Greatest length, 116.9, 109.9, 110.7; orbital width, 64.8, 59.9, 61.3; postorbital constriction, 50.3, 48.1, 49.2; width of brain case, 61.6, 60.7, 60.8; zygomatic breadth, 70.2, 69, 69; maxillary tooth row, 32.2, 32.6, 29.2.

*Remarks*.—*Ateles hybridus* was based on specimens presented to the Paris Museum by M. Plée in 1826. They were collected in the valley of the Río Magdalena, Colombia, but no definite locality was given. It is now known to be a well-marked form with an extensive range, and for precision we restrict the type locality to La Gloria, on the Río Magdalena in the southern part of Magdalena Department, Colombia, where the animal appears to be typical. *Ateles albifrons* Gray was described from South America without definite locality. According to Elliot (A review of the Primates, vol. 2, p. 45, June 15, 1913), the type in the British Museum is stated on the ticket to be from Medellín, Colombia. That important town was for many years a headquarters for dealers in natural-history specimens, many of which labeled as from there are known to have been collected elsewhere, and it is not improbable that the type of *albifrons* may have been taken at some other locality. At any rate, descriptions of the type agree so well with *hybridus* that the name may be assumed to belong in synonymy under it.

Another spider monkey, [*Ateles belzebuth*] *brunneus*, was described by Gray (Catalogue of the monkeys, lemurs and fruit-eating bats in the collection of the British Museum, p. 44, 1870) as the fourth color variety of *belzebuth*. The original description of this specimen, which was stated to have come from Brazil, is as follows: "Brown, or brown-washed grey; cheek, loins, and outside of the thighs whiter; chest, throat, inside of limbs pale grey; crown, outside of limbs, and upper surface of tail darker brown." Philip Hershkovitz has recently examined the type of *brunneus* at our request and writes that it is identical with *hybridus*. The type has been exhibited as a mounted specimen and is considerably faded.

In cranial characters *hybridus* seems to be identical with *belzebuth*, and the similarity in color pattern strongly indicates that the two are

conspecific. On the other hand, the cranial details as well as color differences point to a departure from *robustus*, a geographic neighbor on the west. This monkey has been reported from as far south as Bolívar in the Cordillera Oriental of Santander Department.

Montandon (La Nature, Paris, No. 2809, vol. 1, p. 440, May 15, 1929; Comptes Rendus Acad. Sci. Paris, vol. 188, No. 11, p. 817, March 11, 1929) has described a monkey under the name of *Amer-anthropoides loysi*, typifying an assumed new family Amer-anthropoidae, from a left affluent of the upper Río Tarra, a tributary of the Río Catatumbo, which flows into Lake Maracaibo, Venezuela. The collector, Dr. François de Loys, observed two individuals and killed the female, and although an effort was made to save the skin and the skull these were subsequently spoiled by humidity. The description was based on notes and a photograph (Montandon, Journ. Soc. Amér. Paris, new ser., vol. 21, pp. 183-195, pl. 5, 1929) of the animal. The absurdity of the conclusions reached by Montandon is pointed out in detail by Cabrera (Rev. Soc. Argentina Cienc. Nat., vol. 10, pp. 204-209, July 12, 1930). The animal photographed seems to be unquestionably an *Ateles* with a triangular white patch on the forehead. Specimens examined by us from the San Calisto district of the upper Río Tarra proved to be *Ateles belzebuth hybridus*, to which the name *Amer-anthropoides loysi* is here relegated in synonymy.

*Specimens examined*.—Total number, 17, as follows: COLOMBIA: La Gloria, Río Magdalena, 2; Las Marimondas, eastern Andes, Fonseca, Magdalena, 5; Puerto Estrella, Río Magdalena, Magdalena, 2; Río Guaimaral, Valledupar, Magdalena, 6; Río Tarra, San Calisto, Santander, 2.

#### ATELES FUSCICEPS FUSCICEPS Gray

##### BROWN-HEADED SPIDER MONKEY

*Ateles fusciceps* GRAY, Proc. Zool. Soc. London for 1865, pt. 3, No. 47, p. 733, Apr. 1866.

*Ateles fusciceps* SCLATER, Proc. Zool. Soc. London for 1872, pt. 2, No. 42, p. 663, pl. 54 (col.), Nov. 1872. (Specimen collected by Clarence Buckley in Trans-andean Ecuador.)

*Type locality*.—South America. [Here restricted to Hacienda Chinipamba, near Peñaherrera (west of Ibarra), Intag District, Imbabura Province, northwestern Ecuador; altitude 1,500 meters.]

*Type specimen*.—British Museum (Natural History) No.———.

*Distribution*.—Pacific side of cordillera of Ecuador.

*General characters*.—A black or brownish-black spider monkey, with top of head more distinctly brownish than body; foot small (150-170 mm.); pelage rather coarse; tail variable in length, usually one-fifth or more longer than head and body, clothed with hair of moderate length. Closely allied to *robustus* of Colombia but more brownish, especially on the head. Compared with *paniscus*, especially as repre-

sented by *A. paniscus chamek* of Peru, the brownish head is distinctive; other differences are the short whitish hairs on chin (chin nearly naked and white hairs absent in *chamek*); shorter, coarser pelage, the crown patch less projecting over forehead, the shorter-haired tail, smaller foot, and cranial details.

*Color*.—Face and upturned hairs on forehead black; crown cap tawny-olive, yellowish wood brown, or with black hairs tipped with burnt umber; remainder of body, including limbs and tail, covered with black hairs tinged with burnt umber.

*Skull*.—Skull of medium size and proportions; premaxillae moderately extended anteriorly; rostrum rather short and nasal opening of medium length; auditory bullae somewhat flattened. Skull similar to that of the related form *robustus*. Compared with that of *paniscus*: Premaxillae less produced anteriorly beyond plane of canines and anterior nasal opening less elongated.

*Measurements*.—An adult male and female from Hacienda Chinipamba, near Peñaherrera, Ecuador, respectively: Total length, 1,090, 1,281 mm.; tail, 720, 770; hind foot, 160, 169. An adult female from Cordillera de Chilluri, Ecuador: Total length, 1,194; tail, 655; hind foot, 152. *Skull*: An adult male and female from Hacienda Chinipamba, near Peñaherrera, Ecuador, respectively: Greatest length, 113.7, 117.2; orbital width, 63.6, 62.5; postorbital constriction, 50.4, 48.9; width of brain case, 61.2, 61.7; zygomatic breadth, 73, 71.2; maxillary tooth row, 32.6, 32.2. An adult female from Cordillera de Chilluri, Ecuador: Greatest length, 113.8; orbital width, 58; postorbital constriction, 47; width of brain case, 59.7; zygomatic breadth, 69.6; maxillary tooth row, 30.2.

*Remarks*.—*Ateles fusciceps* was based on a specimen from an unknown locality. Another specimen of this well-marked monkey was collected by Clarence Buckley in Transandean Ecuador, as recorded by Selater (*op. cit.*), who also published a colored plate. For precision in regard to the type locality, however, the name is restricted by us to the form occurring at Hacienda Chinipamba, near Peñaherrera (west of Ibarra), Intag District, Imbabura Province, northwestern Ecuador, where the altitude is given as 1,500 meters.

Lönnberg (Arkiv för Zool., vol. 14, No. 4, p. 5, June 7, 1921) has recorded specimens from near Gualea (alt. 4,000 feet) and Santo Domingo de los Colorados (alt. 2,000 feet) on the upper tributaries of Río Esmeraldas, northwestern Ecuador.

*Specimens examined*.—Total number, 8, as follows: ECUADOR: Carolina Ibarra, Imbabura Province, 1 (skull only, U. M. M. Z.); Cordillera de Chilluri, 1 (U. M. M. Z.); Gualea (near), Pichincha Province, altitude 3,000–4,000 feet, 1 (M. C. Z.); Hacienda Chinipamba, near Peñaherrera, Intag District, Imbabura Province, 2 (U. M. M. Z.); Mindo (below), Pichincha Province, altitude 4,000 feet, 1 (M. C. Z.); Par-

amba, Imbabura Province, 1 (skull only, U. M. M. Z.); no definite locality, 1 (U. M. M. Z.).

ATELES FUSCICEPS ROBUSTUS J. A. Allen

COLOMBIAN BLACK SPIDER MONKEY

*Ateles robustus* J. A. ALLEN, Bull. Amer. Mus. Nat. Hist., vol. 33, art. 43, p. 652, Dec. 14, 1914.

*Ateles dariensis* GOLDMAN, Proc. Biol. Soc. Washington, vol. 28, p. 101, Apr. 13, 1915. Type locality, near head of Río Limón, Mount Pirre, eastern Panama; altitude 5,200 feet.

*Type locality*.—Gallera, Department of Cauca, western Andes, Colombia; altitude, 5,000 feet.

*Type specimen*.—Male adult, skin and skull, American Museum of Natural History No. 32354, collected July 13, 1911, by Leo E. Miller.

*Distribution*.—Western cordillera of Andes from southwestern Colombia northward on west side of Río Cauca to eastern Panama (Mount Pirre).

*General characters*.—All black, except for a slight brownish tinge on forehead of one individual and a few inconspicuous white hairs on chin and about mouth; hairs on back harsh and of medium length (majority of hairs on midline 40–70 mm. in length); tail variable in length, occasionally nearly twice as long as head and body; hind foot small (160–170 mm.); tail hairs of moderate length (30–50 mm. on upperside). Closely allied to *fusciceps* of Ecuador but more nearly uniform black in color, without the distinctly brownish head of *fusciceps*. Similar in color to *paniscus* of northern Brazil, but with a few white hairs on chin (chin nearly naked and white hairs absent in *paniscus*); foot smaller; hair on back and tail shorter; skull differing in detail. Differs from *geoffroyi* and subspecies of Middle America in nearly uniform black, instead of diverse coloration, varying from light buff to ferruginous.

*Color*.—Face and entire pelage deep glossy black, except in some specimens having a slight brownish tinge on the forehead and a few whitish hairs on chin and about mouth.

*Skull*.—About as in the related form *fusciceps*. Very similar to that of *paniscus*, but premaxillae less produced anteriorly beyond plane of canines; anterior nasal opening less elongated. Closely resembling that of *geoffroyi*, but rostrum longer; anterior profile rising less steeply from ends of premaxillae; auditory bullae usually more flattened.

*Measurements*.—Type (from original description): Total length, 1,220 mm.; tail, 630; hind foot, 160. Two adult female topotypes, respectively: Total length, 1,150, 1,260; tail, 600, 750; hind foot, 155, 160. *Skull*: Two adult female topotypes, respectively: Greatest length, 115.3, 111.7; orbital width, 58.9, 62.2; postorbital constriction,

47.9, 44.7; width of brain case, 59.1, 57.2; zygomatic breadth, 65.9, 69.1; maxillary tooth row, 28.8, 31.1.

*Remarks.*—*Ateles dariensis* was based on a single specimen from eastern Panama, exhibiting characters that prove to be inconstant in additional specimens examined, and the name must be relegated to the synonymy of *robustus*. Despite the marked contrast in color between this black form and the red monkey of eastern Panama, the agreement in nearly all cranial details suggests close relationship. The auditory bullae are usually more flattened in *robustus*, but even this feature is not always distinctive. To the southward, on the other hand, close alliance with *fusciceps* is indicated by the slight brownish tinge on the forehead in at least one individual, and apparent identity in cranial details. Allen (Bull. Amer. Mus. Nat. Hist., vol. 35, p. 235, May 31, 1916) records a specimen of this spider monkey from Barba-coas, Nariño Department, southwestern Colombia.

Gray (Ann. Mag. Nat. Hist., ser. 4, vol. 11, No. 66, p. 468, June 1873) has recorded "*Ateles ater*" from the vicinity of Concordia, Antioquia, Colombia. Elliot (A review of the Primates, vol. 2, p. 30, June 15, 1913) under the same name lists Cereté on the Río Sinú, Bolívar, Colombia, as a locality record. Festa (Boll. Mus. Zool. ed Anat. Comp. Univ. Torino, vol. 18, No. 435, p. 4, Feb. 11, 1903) likewise identifies a female taken in forest near the Río Lara, which empties into an arm of Golfo de San Miguel, Panama, as *Ateles ater*. Anthony (Bull. Amer. Mus. Nat. Hist., vol. 35, No. 20, p. 375, June 9, 1916) refers to two specimens collected at Tapalisa, Panama.

It is therefore evident that this black spider monkey ranges from the Serranía del Darién (Cerro Pirre and Tapalisa) southward along the mountain ranges bordering the Río Sinú in Bolívar to the mountain range west of the Río Cauca (Concordia), and southward at least to southwestern Colombia (Barbacoas).

*Specimens examined.*—Total number, 7, as follows: COLOMBIA: Gallera (type locality), 2 (A. M. N. H.). PANAMA: Cituro, 1 (A. M. N. H.); Mount Pirre, 1; Tapalisa, 1 (A. M. N. H.); Río Bayano, 1 (skull only, M. C. Z.); Río Tuyra, 1 (skull only, M. C. Z.).

#### ATELES GEOFFROYI GEOFFROYI Kuhl

##### NICARAGUAN SPIDER MONKEY

*Atele[s] geoffroyi* KÜHL, Beiträge zur Zoologie und vergleichenden Anatomie, Abth. 1, p. 26, 1820. (Printed also on same page as "*Ateles Geoffroyi. mihi species inedita.*")

*Ateles melanochir* DESMAREST, Encyclopédie méthodique (Zoologie), Mammalogie, pt. 1, p. 76, 1820. [Based on specimen in Mus. Nat. Hist. Nat. Paris.] Type locality, unknown.

*Ateles melanochir* SCLATER, Proc. Zool. Soc. London for 1875, pt. 3, No. 27, p. 419, pl. 48 (col.), Oct. 1875.

*Ateles melanocercus* SCHLEGEL MS., in Jentink, Catalogue systématique des mammifères, Mus. Hist. Nat. Pays-Bas Leiden, vol. 11, p. 43, 1892 (*nomen nudum*).

*Type locality*.—Unknown [Here restricted to San Juan del Norte (Greytown), Nicaragua; see "*Ateles hybridus*" Sclater, Proc. Zool. Soc. London for 1862, pt. 2, No. 12, p. 186, Sept. 1862 (specimen from Río Rana, Gorgon Bay, near San Juan del Norte); and Salvin in Alston, Biologia Centrali-Americana, Mammalia, vol. 1, pp. 9–10, Sept. 1879.]

*Type specimen*.—Female adult, Muséum National d'Histoire Naturelle, Paris (menagerie specimen acquired in 1819; see I. Geoffroy, Catalogue méthodique de la collection des mammifères, pt. 1 (Catalogue des Primates), p. 49, 1851.)

*Distribution*.—Coastal region bordering San Juan del Norte or Martina Bay, southeastern Nicaragua; probably ranging across through the lowlands to the Pacific coast.

*General characters*.—Distinguished by light buff, overlaid with dusky tipped hairs, in general coloration; dark markings on head and limbs variable and inconspicuous as a rule. Most closely resembling *frontatus* of northwestern Costa Rica, but lighter and dark markings much more restricted. Contrasts strongly with *ornatus* of eastern Costa Rica in light buff instead of rich rufescent coloration. Differs from *A. fusciceps robustus* of eastern Panama and western Colombia in diverse instead of nearly uniform black coloration.

*Color*.—Face and eyebrows varying from blackish to a mixture of black and buffy hairs, those on the brows directed upward to form a thin ruff; top of head thinly overlaid with blackish or brownish hairs directed forward, the under color usually light buff. Crown cap grading from black to buff tinged with brownish; stiff long black hairs above eyes concealing to variable extent the white or buff triangular forehead patch; upperside of neck, entire dorsal area, upperpart of arms all around and of legs to ankles all around, except knees, light buff thinly intermixed with long black or brownish hairs; narrow areas usually extending 2 or 3 inches up and down over knees black, the hairs black to roots, but in one specimen the knee patches are limited to a few overlying dusky hairs; elbows and outer sides of forearms more or less distinctly blackish; throat and sides of face and neck silky light buff to light ochraceous-buff; underparts dull light buff; hands and feet blackish; tail above about like back, below somewhat paler along basal portion, but with a narrow line of dusky hairs bordering callosity near tip. In one specimen all the darker areas are reduced and the general pelage is suffused with light ochraceous-buff, becoming near cinnamon-buff on inguinal region. In another individual small cinnamon-buff areas appear on shoulders, inner sides of wrists, sides of feet, and near middle of underside of tail.

*Skull*.—Very similar to that of *ornatus* but apparently smaller.

*Measurements*.—No external measurements available. *Skull*: An adult and a subadult female from Nicaragua, respectively: Greatest



length, 103.7, 101.5 mm.; orbital width, 58.7, 52.7; postorbital constriction, 46.8, 45.9; width of brain case, 55.7, 56.2; zygomatic width, 61.6, 56.8; maxillary tooth row, 28. 26.2.

*Remarks.*—*A. geoffroyi* appears to be the first identifiable name applied to a spider monkey from Middle America. At the time it was described the locality from which the type specimen came was unknown. Much general evidence, however, indicates that this is the so-called gray spider monkey, also described as *A. melanochir*, now known to inhabit southeastern Nicaragua, and that this general gray (really light buff) style of monkey may range across through the lowlands of the Río San Juan to the vicinity of Lake Managua and Lake Nicaragua. It is interesting to note that a very young example of *frontatus* as figured by Gray (Zool. Voy. *Sulphur*, vol. 1, No. 1, Mammalia, pt. 1, pl. 1, Apr. 1843) has essentially the same light-gray color pattern as that of the adult of *geoffroyi*. It is probable that the type of *geoffroyi* came from San Juan del Norte, and for precision we restrict the name to the animal that occurs in the vicinity of that locality. A specimen from Río Rana, Gorgon Bay, near San Juan del Norte (Sclater, *op. cit.*, p. 186, 1862) was subsequently listed by Gray (Catalogue of monkeys, lemurs and fruit-eating bats in the collection of the British Museum, p. 43, 1870) as "*Ateles hybridus*" from "St. Juan, Nicaragua." A very good description of this spider monkey, based on field observations, was given by Salvin to Alston (Biologia Centrali-Americana, Mammalia, vol. 1, pp. 9-10, Sept. 1879). Confusion of the Nicaraguan race with *A. hybridus* by Gray was undoubtedly due to external resemblance, which is rather striking; but cranial characters indicate close alliance with geographic neighbors that are markedly different in coloration. A specimen (M. C. Z. No. 29626) from El Valle del Antón, near the Pacific coast east of the Azuero Peninsula in Panama, agrees closely in general coloration with those from Nicaragua, but the black on the crown patch and on forearms is more extensive. Whether this animal was native to the locality or brought from some other region seems somewhat uncertain.

*Specimens examined.*—Total number, 10, as follows: NICARAGUA: Managua, 6; no definite locality, 4 (1, A. M. N. H.).

#### ATELES GEOFFROYI VELLEROSUS Gray

##### MEXICAN SPIDER MONKEY

*Ateles vellerosus* GRAY, Proc. Zool. Soc. London for 1865, pt. 3, No. 47, p. 773, Apr. 1866.

*Ateles vellerosus* SCLATER, Proc. Zool. Soc. London for 1872, pt. 1, No. 1, p. 5, pl. 2 (col.), June 1872. (Believed by A. Boucard to have been procured near Acapulco, Mexico.)

*Ateles neglectus* REINHARDT, Vid. Medd. Nat. Foren. Kjöbenhavn, ser. 8, vol. 4 (1872), Nos. 6-9, p. 150, 1873. Type locality, Mirador, Veracruz, Mexico.

*Ateles tricolor* HOLLISTER, Proc. Biol. Soc. Washington, vol. 27, p. 141, July 10, 1914. Type locality, Hacienda Santa Efigenia, 8 miles north of Tapanatepec, southeastern Oaxaca.

*Type locality*.—?Brazil. [Here restricted to Mirador, about 15 miles northeast of Huatusco, Veracruz, Mexico; altitude 2,000 feet.]

*Type specimen*.—No. ———, British Museum (Natural History).

*Distribution*.—Unbroken forests of Veracruz and eastern San Luis Potosí and southeastward through Tabasco, across the Isthmus of Tehuantepec in eastern Oaxaca, to Honduras and El Salvador, except for highlands of Guatemala.

*General characters*.—A subspecies distinguished by combination of black or brownish-black top of head, neck, and shoulders, in contrast with buffy lumbar region, and pinkish-buff to cinnamon-buff underparts. Differs from *yucatanensis* of Quintana Roo in deeper buff underparts (underparts in *yucatanensis* silvery white or light buff). Differs from *pan* of Guatemala in greater contrast in colors of upperparts (in *pan* the upper back and lumbar region are more nearly uniform blackish in tone).

*Color*.—Top of head, neck, shoulders, outer surfaces of fore and hind limbs, and forearms all around varying from black to brownish black, passing near middle of back into cinnamon-buff or cinnamon and extending across lumbar region and including hips, the latter colors somewhat darkened along median line by overlying brownish hairs; underparts in general, including inner sides of arms in a strip narrowing from armpit to a point near elbows and on inner sides of legs to near ankles, varying from pinkish buff to cinnamon-buff, becoming near cinnamon on sides of body; underside of neck varying from grayish to a mixture of buffy-gray and brown; face blackish, but lips and small tufts near sides of mouth are dull whitish in some specimens; hands and feet black; tail above black or brownish black, mixed below with buffy hairs in a median line gradually narrowing from base to near callosity.

*Skull*.—Rather narrow, but closely similar in general to those of the other subspecies. Compared with *yucatanensis* the frontal region of the skull is slightly flatter, less convex along median line anteriorly, as shown in profile.

*Measurements*.—Two adult males from Santa Efigenia, Oaxaca, respectively: Total length, 1,200, 1,260 mm.; tail vertebrae, 760, 765; hind foot, 176, 178. Average of 7 adult females from Santa Efigenia, Oaxaca: Total length, 1,204 (1,140–1,301); tail vertebrae, 751 (700–780); hind foot, 179 (178–185). *Skull* (three adult males from Santa Efigenia, respectively): Greatest length, 110.1, 112.5, 110.9; orbital width, 60, 56.3, 57.2; postorbital constriction, 51.3, 47.6, 47; width of brain case, 59.3, 58.5, 59.6; zygomatic width, 70.5, 63.9, 68.5; maxillary tooth row, 28.9, 29.9, 29.9. Average of 7 adult females

from Santa Efigenia, Oaxaca: Greatest length, 108.2 (105.2–113.4); orbital width, 56.2 (54.5–58.8); postorbital constriction, 46.7 (45.5–48.7); width of brain case, 58 (55.9–60.2); zygomatic width, 63.5 (59.2–66.9); maxillary tooth row, 28.5 (27.2–29).

*Remarks.*—*A. vellerosus* was originally assigned by Gray to Brazil, but this appears to have been an error, as pointed out by Alston (*Biologia Centrali-Americana*, Mammalia, vol. 1, p. 10, Sept. 1879). By some subsequent authors, including Alston, the name was applied to spider monkeys from Mexico without definite locality. Incidentally, the plate illustration of Sclater (*op. cit.*) closely resembles this form. It represents a specimen believed by Boucard to have been procured near Acapulco, Guerrero, where it could not have been native, as no monkeys occur in that general region. Under the name *vellerosus* Thomas (Proc. Zool. Soc. London for 1890, pt. 1, p. 72, June 1890) recorded specimens taken in Veracruz at the following localities: Raya de Boca Agustín, Misantla; boundaries of Misantla and Jalapa; and Hacienda de Tortugas, Jalapa. At the time *A. tricolor* from south-eastern Oaxaca was described (*op. cit.*) by Hollister, *vellerosus* was not recognized by him, and the name *A. neglectus* of Veracruz was overlooked. The following year, however, Hollister (Proc. Biol. Soc. Washington, vol. 28, p. 142, 1915) regarded *tricolor* and *neglectus* as identical. The various descriptions of *vellerosus* apply well to the series of specimens now available from both Veracruz and Oaxaca, under which we, therefore, include both *neglectus* and *tricolor* as synonyms. For precision we would restrict the name *vellerosus* to the form known to occur near Mirador, Veracruz, the type locality, incidentally of the later name, *neglectus*.

The range of subspecies *vellerosus* marks the northern limit of the group in Middle America. It inhabits unbroken forested regions from near sea level to about 4,000 feet altitude, including some of the areas of heaviest and most continuous rainfall in Mexico. William Lloyd, a field agent of the former Biological Survey, writing of the mammals of the vicinity of Victoria, Tamaulipas, in 1891, stated that "a monkey has been said to have been taken a little south of here, but the most authentic information says they are not found north of a point west of Escandon, rather more than 50 leagues south." It is possible that spider monkeys ranged north into southern Tamaulipas, but information obtained in 1898 indicated that the northern limit was then near Xilitla, southeastern San Luis Potosí.

The German naturalist Ferdinand Deppe, in 1825, purchased a live *Ateles* in Alvarado, Veracruz, which had been caught by a Mexican about 20 hours distant from that city. Afterward, Deppe (Sclater, Nat. Hist. Rev., vol. 1, No. 4, pp. 508–509, Oct. 1861) while en route from Caxaia to Alvarado, observed a "great number" of *Ateles* in a forest near Valle Real.

One specimen from Juchitán, Oaxaca, has silvery whitish underparts, and another from the same locality is normally colored. A very young individual from Santa Efígenia, Oaxaca, does not differ appreciably in color from adults from the same locality. One very young one from Tehuantepec has the upperparts normally colored, and another from the same locality is unusually dark, the lumbar region nearly as dark as the upper back.

*Specimens examined.*—Total number, 59, as follows: MEXICO: Oaxaca: Juchitán, 3 (A.M.N.H.); Oaxaca, without definite locality, 4 (A. M. N. H.); Santa Efígenia, 13; Tehuantepec, 4 (one skull without skin, A.M.N.H.; one skull without skin, U.M.M.Z.); Tuxtepec, 2. Tabasco: Teapa, 1. Veracruz: Barranca de Boca, Canton de Jalapa, 1 (skin only); Cuatotolapan, 2 (skulls only, U. M. M. Z.); Pasa Nueva, 19 (2 skulls without skins, A. M. N. H.). HONDURAS: Tegucigalpa: Cantoral, 1 (A.M.N.H.); Guaymaca, 2 (A.M.N.H.). Olancho: Catacamas, 1 (A.M.N.H.). Ocotepeque: El Chorro, east side of Ocotepeque, 4,500 feet, 1 (skin only, A.M.N.H.). EL SALVADOR: San Miguel: Lake Olomega [=Laguna Lomego], 5 (C. D.).

ATELES GEOFFROYI YUCATANENSIS, new subspecies

YUCATÁN SPIDER MONKEY

*Type locality.*—Puerto Morelos, northeast coast of Quintana Roo, Mexico; altitude 100 feet.

*Type specimen.*—Male adult, skin and skull; U. S. N. M. No. 108531 (Biological Surveys collection); collected April 2, 1901, by E. W. Nelson and E. A. Goldman; original number 14652.

*Distribution.*—Forests of the Yucatán Peninsula, northeastern Guatemala, and probably adjoining parts of British Honduras; doubtless intergrading to the southward with *vellerosus*.

*General characters.*—A rather small, slender, light-colored race, with entire underparts silvery whitish or very pale buff, pelage short and thin. Size about as in *vellerosus* of Veracruz but decidedly paler, especially on underparts where in typical specimens a whitish silvery tone extends to neck and inner sides of limbs; underside of tail cream-buff to near callosity; frontal outline of skull more prominent.

*Color.*—Type: Top of head, neck, and outer surfaces of forelimbs brownish black, passing gradually through cinnamon-drab and light drab on shoulders and anterior part of back to near olive-buff on hips, the light drab extending along median line to base of tail; face mainly dusky, but cheeks whitish; knees brownish black; rest of outer surfaces of hind limbs cinnamon-drab; entire underparts including underside of neck, inner surfaces of limbs to wrists and ankles thinly haired, between cream-buff and silvery whitish; hands and feet blackish; tail cinnamon-drab above and on sides, becoming cream-buff below along median line from base to near callosity.

*Skull*.—Similar in size to that of *vellerosus*, but frontal profile more convex anteriorly; dentition rather light.

*Measurements*.—Type: Total length, 1,150 mm.; tail vertebrae, 766; hind foot, 181. Two adult male topotypes, respectively: Total length, 1,141, 1,090; tail vertebrae, 744, 817; hind foot, 167, 174. Three adult female topotypes: Total length, 1,176, 1,150, 1,056; tail vertebrae, 756, 766, 713; hind foot, 169, 171, 165.

*Skull* (type and two adult male topotypes, respectively): Greatest length, 109.7, 105.7, 107.8; orbital width, 57.2, 53.9, 55.6; postorbital constriction, 47.8, 44.8, 45.8; width of brain case, 59.5, 56.8, 57.3; zygomatic width, 65.3, 61, 66.3; maxillary tooth row, 27.3, 27.5, 28. Three adult female topotypes, respectively: Greatest length, 104.8, 108.5, 104.8; orbital width, 52.8, 54.1, 53.1; postorbital constriction, 44.6, 45.8, 45.6; width of brain case, 55.1, 57.2, 57; zygomatic width, 58.3, 60.2, 60.3; maxillary tooth row, 25.7, 29.8, 28.7.

*Remarks*.—The spider monkey of the Yucatán Peninsula is readily distinguished by the silvery whitish underparts. Specimens from Apazote, Campeche, and Uaxactum, Guatemala, are referable to the present form, but in slightly darker and more buffy underparts they indicate gradation toward *vellerosus*. One topotype and a young without definite locality have sparse white hairs on the anterior part of the crown and a vestige of a white forehead patch partially concealed by stiff black hairs.

*Specimens examined*.—Total number, 16, as follows: MEXICO: Campeche: Apazote, 1. Quintana Roo: Puerto Morelos, 6. GUATEMALA: Uaxactum, 8 (U. M. M. Z.). No definite locality, 1 (A. M. N. H.).

#### ATELES GEOFFROYI PAN Schlegel

#### GUATEMALAN SPIDER MONKEY

*Ateles pan* SCHLEGEL, Mus. Hist. Nat. Pays-Bas Leiden, vol. 7, livr. 12 (Monogr. 40, Simiæ), p. 180, 1876.

*Type locality*.—Cobán, Alta Vera Paz, Guatemala.

*Type specimen*.—Cotypes, adult male and two adult females, Muséum d'Histoire Naturelle des Pays-Bas, Leiden.

*Distribution*.—Mountains of central Guatemala; doubtless intergrading with *vellerosus*.

*General characters*.—A very dark spider monkey with lumbar region only slightly, if at all, lighter than shoulders and thus lacking the contrasting dorsal areas presented by *vellerosus* and other Middle American races; pelage long and dense.

*Color*.—Face, top of head, shoulders, outer surfaces of limbs, forearms all around, feet, and entire tail black or brownish black. In one specimen the dark color extends nearly uniformly over all of the upperparts, but in two others the lower part of the back is suffused with cinnamon partially concealed by overlying dusky hairs; under-

side of neck and throat thinly covered with mixed brownish and buffy hairs; rest of underparts, including a strip narrowing from armpit to a point near inner side of elbow, and inner sides of hind limbs to ankles between pinkish buff and cinnamon-buff, becoming deep cinnamon or rusty along sides of body.

*Skull*.—About as in *vellerosus*.

*Measurements*.—No external measurements available. *Skull*: Two adult females from Guatemala, respectively: Greatest length, 109.1, 105.1; orbital width, 57.3, 59.4; postorbital constriction, 48, 50; width of brain case, 60.2, 62.4; zygomatic width, 66.8, 68.8; maxillary tooth row, 27.8, 27.5.

*Remarks*.—Three specimens exhibited by the Guatemalan Government at the World's Columbian Exposition were presented to the U. S. National Museum. These were labeled "Guatemala" without definite locality but are believed to be from Alta Vera Paz and probably represent typical *Ateles pan.* Aside from the very dark coloration, the coat is long and heavy, indicating that they came from a high elevation in the mountains. The skulls indicate close agreement with *vellerosus* in size and general details.

*Specimens examined*.—Total number, 3, as follows: GUATEMALA: Alta Vera Paz, 3.

#### ATELES GEOFFROYI FRONTATUS (Gray)

##### BLACK-FOREHEADED MIRIKI OR SPIDER MONKEY

*Eriodectes frontatus* (GRAY, Ann. Mag. Nat. Hist., ser. 1, vol. 10, No. 65, p. 256, Dec. 1842.

*Brachyteles frontatus* GRAY, Zoology of the voyage of H. M. S. *Sulphur*, vol. 1, No. 1, Mammalia, pt. 1, p. 9, pl. 1 (col.), Apr. 1843.

*Type locality*.—South America [=harbor of Culebra, León=Culebra, Bay of Culebra, Guanacaste, northwestern Costa Rica, *vide* Gray, Zool. Voy. H.M.S. *Sulphur*, vol. 1, No. 1, Mammalia, pt. 1, p. 10, Apr. 1843.]

*Type specimen*.—Female adult with young shot by Capt. Sir Edward Belcher; British Museum (Natural History) No. ———.

*Distribution*.—Northwestern Costa Rica and extreme western and northern Nicaragua.

*General characters*.—Similar in pattern of coloration, that is, the normal restriction of black areas to top of head and irregularly to outer surfaces of limbs, to *geoffroyi* of southeastern Nicaragua, but body darker, the ground color of upperparts near buckthorn brown or Mars brown and of underparts honey yellow to tawny, instead of light buff. Differs from *panamensis* of Panama in brownish instead of deep ferruginous general body color. Differs from *vellerosus* of Veracruz in the restriction of black areas on anterior part of back and more yellowish tone of lumbar region.

*Color*.—Face, forehead, top of head, and in some specimens back of neck and shoulders black; anterior part of crown patch more or less suffused with cinnamon-buff, owing to light basal color of hairs, and tending to form a transverse band across forehead; side whiskers on face light buff to cream-buff; upperparts in general buckthorn brown to Mars brown, sparsely or noticeably intermixed with blackish hairs (especially on midline of back in some individuals); belly honey yellow to tawny, extending downward on inner surfaces of legs to ankles, and a lighter tone near cinnamon-buff extending downward on inner surfaces of arms to wrists; outer surfaces of arms and legs usually black (in some individuals restricted more or less to elbow and knee patches); side whiskers on face light buff to cream buff; tail usually sharply bicolor, black or dusky above to tip and tawny below to callosity (when otherwise, mixed light and dark hairs cover the tail above and below).

*Skull*.—About as in *panamensis*, averaging somewhat broader than in *geoffroyi* or *vellerosus*.

*Measurements*.—No external measurements available. *Skull*: An adult male from Peña Blanca: Greatest length, 109.3; orbital breadth, 59.4; postorbital constriction, 49; width of brain case, 58.6; zygomatic breadth, 69.6; maxillary tooth row, 28.4. Two adult females from Lavalá and Tuma, Nicaragua, respectively: Greatest length, 117.3, 112; orbital width, 64.2, 60.2; postorbital constriction, 51.1, 51; width of brain case, 62.8, 59.8; zygomatic breadth, 71.4, 65; maxillary tooth row, 29.6, 28.4.

*Remarks*.—*A. geoffroyi frontatus* is assumed to be a recognizable subspecies, although aside from the type in the British Museum, from northwestern Costa Rica, little is definitely known of its characters or distribution. Certain specimens from Costa Rica without definite locality, and from various localities in Nicaragua, are tentatively referred to *frontatus*, although in none of these is the black on the head so restricted as in the type as figured by Gray (*op. cit.*). The color pattern in this form suggests close relationship to *geoffroyi*, which might also be expected on geographic grounds. A very young individual (U. S. N. M. No. 61208) from Costa Rica, without definite locality, closely resembles Gray's figure just mentioned in light coloration. A skull of an old female from Lavalá, Nicaragua (A. M. N. H. No. 28419), is one of the largest examined from anywhere in Middle America.

*Specimens examined*.—Total number, 38, as follows: COSTA RICA: 3 (without definite locality). NICARAGUA: Lavalá, 2 (skulls only, A. M. N. H.); Peña Blanca, 3 (A. M. N. H.); Río Siquia, 2 (skulls only, U. M. M. Z.); Río Yoya, a tributary of Río Principolca, 25 (skulls only, A. H. S.); Tuma, 2 (skulls only, A. M. N. H.); Uluce, 1 (A. M. N. H.).

## ATELES GEOFFROYI ORNATUS Gray

## COSTA RICA ORNATE SPIDER MONKEY

*Ateles ornatus* GRAY, Catalogue of monkeys, lemurs and fruit-eating bats in the collection of the British Museum, p. 44, 1870.

*Type locality*.—Unknown. [Here restricted to Cuabre, Talamanca region, southeastern Costa Rica.]

*Type specimen*.—British Museum (Natural History) No. ———.

*Distribution*.—Eastern slope of central cordillera of Costa Rica; doubtless intergrading with *panamensis* on Pacific side of the central mountain range.

*General characters*.—A dark golden-yellowish subspecies, the upperparts in strong light having a glossy, golden-yellow sheen, owing to the yellowish subterminal bands of hairs. Resembling *panamensis* of Panama and western Costa Rica but brighter, more golden yellowish in tone, the back, however, more obscured by overlying black-tipped hairs, throat lighter, underside of tail and inner side of upper arm lacking the deep "ferruginous" of *panamensis*. Differs from *frontatus* of Guanacaste, northwestern Costa Rica, in greater extension of black area on limbs and over back of neck and shoulders, and black-tipped hairs overlying and tending to modify the golden-yellowish tones on back. Contrasting strongly in golden yellowish, instead of light buffy coloration, with *geoffroyi* of the coast region of southeastern Nicaragua.

*Color*.—Face, top of head, forearms all around, outer sides of legs, hands, and feet black; upperparts from shoulders to hips and base of tail glossy golden-yellow or apricot buff, varying in some specimens to cinnamon-rufous, more or less overlaid with blackish hairs; chest near cinnamon-buff, the rest of underparts and flanks becoming near tawny or cinnamon-rufous, this general color extending down along inner sides of legs in some specimens nearly to ankles; throat and underside of neck near pinkish buff; tail black above, more or less mixed with tawny below from base to near callosity.

*Skull*.—About like that of *panamensis*; similar to that of *geoffroyi*, but apparently somewhat larger.

*Measurements*.—No external measurements available. *Skull*: Three adult males from Talamanca region, Costa Rica, respectively: Greatest length, 110.2, 111.2, 113.8 mm.; orbital width, 63.3, 61.7, 62; postorbital constriction, 45.2, 45.7, 49.6; width of brain case, 61.6, 58, 61.7; zygomatic breadth, 71.5, 68.2, 71.9; maxillary tooth row, 27.6, 30.9, 27.9. Average of 6 adult females from Talamanca region, Costa Rica: Greatest length, 108.1 (104.5–114.4); orbital width, 61.6 (56.4–64.1); postorbital constriction, 47.4 (44.8–49.1); width of brain case, 58.7 (55.7–61.8); zygomatic width, 66.8 (63.7–70.7); maxillary tooth row, 27.5 (26.3–29.5).

*Remarks*.—Much confusion has existed regarding the status of this brightly colored subspecies. Specimens that we believe belong here



have commonly been referred somewhat doubtfully to *A. geoffroyi* Kuhl. The description of *A. ornatus* by Gray (*op. cit.*), from an unknown locality, applies so well to specimens from eastern Costa Rica that their identity seems unmistakable. A more detailed description of the type than that published by Gray is given by Elliot (A review of the Primates, vol. 2, p. 45, June 1913). The glossy quality as well as bright colors of the pelage suggests the propriety of the name *ornatus*. The contrast in color with plain buffy *geoffroyi* of southeastern Nicaragua is very great, but close agreement in cranial characters and other evidence indicate probable intergradation.

*Specimens examined*.—Total number, 14, all from COSTA RICA as follows: Cataratas, Río San Carlos, 2 (A. M. N. H.); Cuabre, Talamanca region 1 (A. M. N. H.); Guapiles, Limón Province, 1 (A. M. N. H.); Santa María, 37 miles south of San José, 3 (skulls only, A. M. N. H.); Talamanca region, 7.

ATELES GEOFFROYI PANAMENSIS, new subspecies

RED SPIDER MONKEY; MONO COLORADO

*Type locality*.—Cerro Brujo, about 15 miles southeast of Portobello, Province of Colón, Panama; altitude 2,000 feet.

*Type specimen*.—Female adult, skin and skull, U. S. N. M. No. 171489 (Biological Surveys collection); collected June 8, 1911, by E. A. Goldman; original number, 21165.

*Distribution*.—Forested regions of Panama east of the Canal Zone (Cordillera de San Blas), and west through Chiriquí to central western Costa Rica.

*General characters*.—A rather large, deeply rufescent race. Very similar to *ornatus* of the Caribbean slope of Costa Rica, but reddish tone more intense, the back less obscured by overlying dusky hairs; inner side of upper arm pinkish cinnamon to ferruginous. Differs from *azuereensis* of Azuero Peninsula, Panama, in deep reddish instead of cinnamon or tawny general coloration.

*Color*.—Type: Upperparts from back of shoulders to base of tail, backs of thighs, and sides of body ferruginous, slightly obscured by black tips of hairs; outer surfaces of fore and hind limbs either black or blackish to knees and elbows; outer surfaces of limbs below knees and elbows either black or with varying admixture of black and ferruginous hairs, the hairs banded but black at tips; underparts thinly haired, pinkish cinnamon on chest and along inner sides of hind limbs to ankles, becoming deep, clear ferruginous or dark dusty reddish over abdomen; face, crown cap on head, and median streak on back of neck blackish; sides of neck covered with a mixture of pinkish buff, cinnamon-buff, and blackish hairs; chin nearly naked; throat and under side of neck thinly clothed with light cinnamon-drab or light brownish hairs; tail above ferruginous heavily mixed with black on basal two-

thirds, becoming clear black toward tip, below deep ferruginous to near callosity where blackish hairs extend all around. The ground color of body in other specimens grades from dark rusty reddish to ferruginous or burnt sienna, and a narrow ferruginous or cinnamon-buff streak usually extends long inner side of upper arm from armpit to elbow.

*Skull*.—Very similar to that of *geoffroyi*, but brain case rather broad.

*Measurements*.—Type: Total length, 1,280 mm.; tail vertebrae, 840; hind foot, 194. An adult male and female from Cerro Azul, respectively: Total length, 1,280, 1,225; tail vertebrae, 786, 785; hind foot, 183, 176. *Skull* (type): Greatest length, 112.8; orbital width, 62; postorbital constriction, 52.4; width of brain case, 61.2; zygomatic breadth, 68; maxillary tooth row, 27.3. An adult male and female from Cerro Azul, respectively: Greatest length, 114.2, 109.1; orbital width, 62.7, 59.4; postorbital constriction, 53, 50.3; width of brain case, 63.2, 61.4; zygomatic width, 70.2, 69.6; maxillary tooth row 31, 28.1.

*Remarks*.—This is the monkey commonly known as “mono colorado” in Panama and western Costa Rica. It is the most intensely red of all the races of Middle America, but despite this it has been generally confused with the light buffy form, *geoffroyi*, of Nicaragua. While the ground color of most of the body appears to be ferruginous to burnt sienna in ordinary light, in strong light and particularly in direct sunlight individual hairs on the upperparts are seen to have glossy subterminal bands giving that part of the pelage a golden-yellowish sheen, a peculiarity still more pronounced in *ornatus* and not shared with the more northern races. The specimens from Chiriquí and as far west as central-western Costa Rica agree closely in color with those from the Canal Zone in the vicinity of the type locality. In one specimen of a series of six skins from Pozo Azul, Costa Rica, a white patch on the forehead is nearly concealed in front by longer black-tipped hairs and the cheeks are dull whitish or pale buffy.

*Specimens examined*.—Total number, 24, as follows: COSTA RICA: Cañas Gordas, Puntarenas, 3 (A. M. N. H.); El Pozo, 12 miles above mouth of Río Grande de Terraba, 1 (skin only, A. M. N. H.); Pozo Azul, 10 miles above mouth of Río Grande de Pirris, 12 (3, C. M.; 4 skins with skulls and 5 extra skulls, A. M. N. H.). PANAMA: Cerro Azul, near head of Chagres River, 2; Cerro Brujo (type locality), 1; Coto, Chiriquí, 2 (M. C. Z.); Río Pequeñi, Canal Zone, 2 (M. C. Z.); San Juan, Chagres River, 1.

#### ATELES GEOFFROYI AZUERENSIS Bole

##### AZUERO SPIDER MONKEY

*Ateles azuerensis* BOLE, Sci. Publ. Cleveland Mus. Nat. Hist., vol. 7, p. 149, Aug. 31, 1937.

*Type locality*.—Altos Negritos, 10 miles east of Montijo Bay (part of the spur forming south drainage divide of Río Negro), Mariato Suay Lands, Azuero Peninsula, Veraguas Province, Panama; altitude, 1,500 feet.

*Type specimen*.—Female adult, Cleveland Museum Natural History No. 1235.

*Distribution*.—Forested mountains of the Azuero Peninsula, Panama, probably in deeper forests on both slopes, but known only from the western (Veraguas) side from the vicinity of Ponuga southward. Possibly ranging west to Burica Peninsula on Panama-Costa Rican boundary.

*General characters*.—A subspecies distinguished from neighboring forms by lighter tawny or ochraceous-tawny general coloration.

*Color*.—Face blackish; top of head and back of neck varying from deep black to a mixture of black and cinnamon-buff, with black predominating; upperparts in general ochraceous-tawny thinly intermixed with black-tipped hairs; shoulders and outer surfaces of arms and legs black; belly similar to back, but paler owing to absence of black-tipped hairs; throat and chest cinnamon-buff, this general tone extending downward to wrists and ankles on inner surfaces of limbs; tail above black, below tawny to proximal end of callosity.

*Skull*.—Rather small and narrow, but very similar otherwise to that of *panamensis*.

*Measurements*.—An adult male and female from type locality, respectively: Total length, 1,170, 1,166 mm.; tail, 720, 701; hind foot, 177, 168. *Skull* (type, from original description): Greatest length, 110.8; width of brain case, 56.8; zygomatic breadth, 65.1; maxillary tooth row, 27.7. An adult male from type locality: Greatest length, 109.8; orbital width, 57.7; postorbital constriction, 44.1; width of brain case, 58.7; zygomatic breadth, 67; maxillary tooth row, 29.7.

*Remarks*.—This subspecies is definitely known only from the heavily forested mountains of the Azuero Peninsula, where it appears to be isolated, but may prove to have a more extended range near the Pacific coast of western Panama. A series of 25 skulls from the Burica Peninsula, near the Panama-Costa Rican boundary, said to be from light-colored skins not saved and, therefore, not available for examination by us, are indistinguishable from those inhabiting regions as far north as Nicaragua. For reasons of geography and light color reported we refer them, tentatively, to *azuereensis*.

*Specimens examined*.—Total number, 27, all from PANAMA, as follows: Altos Negritos, Azuero Peninsula (type locality), 2 (C. M. N. H.); Río La Vaca, near Puerto Armuelles, Burica Peninsula, 25 (skulls only, A. H. S.).

## ATELES GEOFFROYI GRIESENS Gray

## HOODED SPIDER MONKEY

*Ateles grisescens* GRAY, Proc. Zool. Soc. London for 1865, pt. 3, p. 732, Apr. 1866.

*Ateles cucullatus* GRAY, Proc. Zool. Soc. London for 1865, pt. 3, p. 733, Apr. 1866.

Type locality, unknown.

*Ateles cucullatus* SCLATER, Proc. Zool. Soc. London for 1871, pt. 1, p. 223, pl. 14 (col.), June 1871.

*Ateles melanochir* SCLATER, Proc. Zool. Soc. London for 1875, pt. 3, p. 419, pl. 49 (col.), Oct. 1875.

*Type locality*.—Unknown. [Here restricted to Río Tuyra, south-eastern Panama.]

*Type specimen*.—British Museum (Natural History) No. —.

*Distribution*.—Presumably the valley of Río Tuyra and probably southeastward through the Serranía del Sapo of extreme southeastern Panama and the Cordillera de Baudo of northwestern Colombia.

*General characters*.—Adults apparently characterized by long, lax pelage and peculiar dusky coloration, with a general admixture of yellowish gray or golden hairs, the hairs on upperparts golden at the base. The skull indicates close relationship to *panamensis*, despite the contrast in the deep reddish color of the latter.

*Color* (type of *cucullatus*).—Skin around orbits and on nose bare and of a brownish flesh color with darker freckles intermixed; cheeks and lower jaw nearly bare of hair, but skin more decidedly of a black shade (Murie, Proc. Zool. Soc. London for 1865, pt. 3, p. 739, Apr. 1866). Hairs very long and lax, those on head projecting forward over forehead; crown and neck black; rest of body above and below, limbs, and tail black intermixed with yellowish-gray or golden hairs, so numerous as to give a pale yellowish-brown coloration to back (not far removed from color on the bases of the hairs in similar parts of *A. grisescens*); hands and feet black, bases of hairs on hands golden, but not on those of feet which are black to the roots (Elliot, A review of the Primates, vol. 2, pp. 38–39, June 1913). Barbour (Journ. Mammalogy, vol. 13, No. 4, pp. 367–368, Nov. 1932) has commented on the skin and skull of a spider monkey (M. C. Z. No. 27490) obtained at Chepigana in Darién, Panama. In this immature specimen, the entire upperparts, including the outer surfaces of fore and hind limbs as well as the upper surface of the tail, are dusky, the darker hairs nearly sooty black on the distal two-thirds and thinly interspersed with these on head, neck, back, thighs, and upper surface of tail are old gold or silvery hairs; the coloration of the upperparts is further modified by a lighter suffusion resulting from the old-gold color of the basal third of these hairs showing through. A partially concealed buffy spot is present on the forehead. The throat and chest are thinly covered with sooty black hairs. On the belly, inner surfaces of hind limbs, and under surface of tail the hairs are dull cinnamon-buff tipped with sooty

black. The inner surfaces of fore limbs are noticeably lighter than the outer and also somewhat lighter than chest. The hairs on hands and feet are lighter at the base than at the tip. The hairs on the forehead project forward as on the type specimen.

*Skull*.—Similar to that of *panamensis*.

*Measurements*.—An adult male (type of *cucullatus*): Head and body, 431±mm.; tail, 698; hind foot, 159 (*vide* Murie, 1866, *op. cit.*, p. 739). *Skull*: Immature specimen from Chepigana: Greatest length, 103; orbital breadth, 52.3; postorbital constriction, 47.6; width of brain case, 55.6; zygomatic breadth, 60; maxillary tooth row, 26.8.<sup>2</sup>

*Remarks*.—A somewhat grizzled spider monkey obtained by E. Greey, an officer on the Royal West-Indian Mail Co.'s steamship *Shannon* at St. Thomas, Virgin Islands, for the Zoological Society of London became the basis of *A. grisescens* of Gray. After the death of the animal, the skin and skull were acquired by the British Museum (Natural History), and the skin was compared by Sclater (Proc. Zool. Soc. London for 1871, pt. 1, p. 223, June 1871) with the skin of a somewhat similar half-grown male purchased from a London dealer in 1869. This specimen, also evidently of unknown native origin, he regarded as probably identical. The type of this spider monkey, according to Elliot (A Review of the Primates, vol. 2, p. 37, June 1913), is entirely black except for the yellowish-brown tint of the underside of the tail, but intermixed with the hairs of the upperparts are long, gray silvery or golden hairs. The latter are not sufficiently numerous to affect the general blackish coloration except on the shoulders, lower back, and the limbs where the hairs are yellow or golden at the base.

The type of *cucullatus*, a male now in the British Museum (Natural History), had a small tubercle representing the thumb, and Sclater (*op. cit.*, 1871, p. 224) remarked that he had "some reason to suppose it may be from the northern coast of Colombia, as . . . a black spider monkey with long hair over its head is occasionally brought for sale into Cartagena."

Attention is here directed to two black-handed spider monkeys figured by Sclater (*op. cit.*, 1875, pl. 49), which were received likewise from officers of the West Indian Mail Co. The color of the face and nose closely resembles that described for *grisescens*, and in addition the distal black color of the hairs on the upperparts does not entirely conceal the yellowish basal color of these hairs. If these specimens are correctly allocated to *grisescens*, it would seem that this spider monkey is subject to considerable variation in external appearance. Owing to the lack of adequate material for study the status of this form remains uncertain.

*Specimens examined*.—Total number, 2, as follows: PANAMA: Chepigana, Darién, 1 (M. C. Z.) No definite locality, 1 (yg., A. M. N. H.).

<sup>2</sup> Hindermost molar has not erupted.

## INCERTAE SEDIS

(?) *ATELES RUFIVENTRIS* Sclater

*Ateles vellerosus* SCLATER, Proc. Zool. Soc. London for 1871, pt. 2, p. 478, Aug. 1871 (nec Gray).

*Ateles rufiventris* SCLATER, Proc. Zool. Soc. London for 1872, pt. 2, p. 688, pl. 57 (col.), Nov. 1872.

*Type locality*.—Río Atrato, Darién, Colombia.

*Type specimen*.—British Museum (Natural History) No.———.

*Remarks*.—Sclater (Proc. Zool. Soc. London for 1871, pt. 2, p. 478, Aug. 1871) stated that the type of *Ateles rufiventris*, a young female, with body length 12 inches, tail 15 inches, was obtained at Colón, Panama, by an officer of the Royal West Indian Mail Co. and that it had been brought from the Río Atrato by one of the American party (presumably the Darién Exploring Expedition under the command of Comdr. T. O. Selfridge, U. S. N.) engaged on the survey of the isthmus for a ship canal. The color of this monkey was described as uniform black except for the flesh-colored face and muzzle and the pale fulvous belly; the color of the latter, however, hardly extending on the inner surfaces of the limbs. A colored illustration for this monkey was subsequently published by Sclater (Proc. Zool. Soc. London for 1872, pt. 2, p. 688, pl. 57 (col.), Nov. 1872). Elliot (A review of the Primates, vol. 2, p. 36, June 15, 1913), however, described this monkey as having the "underparts extending a short distance on inner side of arms and legs, bright rufous," and the line between the color of the underparts and the black of the body as sharply defined.

Determination of the status of the name *Ateles rufiventris* presents some difficulty at the present time. The relative lengths of head and body to that of the short-haired tail, the color pattern, and direction of hair on crown and forehead correspond closely with these features in *Alouatta palliata aequatorialis*, young females of which also lack the bushy beard present on the throat in the males. These resemblances are shown very well by two slightly larger young howlers (U. S. N. M. Nos. 3349, 3359) also from the Río Atrato. It seems unlikely that representatives of both *Ateles* and *Alouatta* with the same color pattern would be found in the same region. Sclater states that the thumb is absent, but examination of skins in the collection shows that the thumb in skins of some young individuals is inconspicuous and might have been overlooked. The hand and feet in the illustration published by Sclater (*op. cit.*) seem more closely to resemble those of *Alouatta* than those of *Ateles*. Elliot (*op. cit.*) states that no skull seems to have been preserved. While all these points may be given consideration final generic allocation must await critical examination of the type, now not available.



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**A REVISION OF THE AMERICAN CLINGFISHES, FAMILY  
GOBIESOCIDAE, WITH DESCRIPTIONS OF NEW GEN-  
ERA AND FORMS**

By **LEONARD P. SCHULTZ**

RECENTLY, while attempting to identify some specimens of clingfishes from the fresh waters of Venezuela and Colombia, South America, it became clear to me that the American Gobiesocidae were in a state of confusion greater than I had suspected from previous work on the group. A search of the literature did not reveal any attempt to straighten out the classification or nomenclature of this family. New species have been described with regularity, but in many cases the describers have ignored the same species long ago named from nearly the same localities. I have made no attempt in this revision to record all the miscellaneous references to American Gobiesocidae, but I have included the most important contributions. To record every reference in the literature would require one to examine the specimens in most of the important museums of the world, which is not possible at the present time. However, that will eventually have to be done if the identifications recorded in numerous instances are to be corrected.

It was found necessary to dissect the skin away from the front of all median fins in order to count all the fin rays. Very few authors have counted the first one or two rays at the beginning of both anal and dorsal fins. The short stubby ray on the dorsal edge of the pectoral fin also is included in my counts. (See table 1.)

The coloration is variable and cannot be used to separate species except to a limited extent.



In this study of the American Gobiesocidae, 9 genera and 25 species and subspecies are recognized. By far the greatest majority of these occur in the tropical Pacific. Although the Gobiesocidae are mostly marine fishes, a few species have been taken in fresh-water streams a short distance above brackish water, clinging to the stones.

*Rimicola* of the Pacific is represented in the Atlantic by the genus *Aoyrtus*, but the genus *Infratridens* has no known Atlantic counterpart. *Arbaciola* has five forms in the Pacific and but one in the Atlantic. *Sicyases* occurs in the Pacific only at the southern part of South America. *Cotylis* has four species in the Pacific and one in the Atlantic. *Sicyogaster* has an interrupted distribution, with one species along the Pacific coast of southern South America and another along the west coast of the United States and British Columbia. *Arcos* has one species on each side of Central America. *Gobiesow* has two species in the Atlantic, and three in the Pacific confined to tropical waters.

Cocos Island presents a problem that needs further study. So far, the Pacific representatives of *Gobiesow cephalus*, and *Cotylis nigripinnis* from the Atlantic, have been taken only on Cocos Island. They are *Gobiesow fulvus* and *Cotylis nigripinnis woodsi*.

The records of *Gobiesow adustus* (Pellegrin, Bull. Mus. Paris, vol. 7, p. 206, 1901, and Günther, Biologia Centrali-Americana, Pisces, p. 4, 1906) in the Río Chapalagana at Téptico in the Río Grande de Santiago may be some other species. No description is given, and thus it is not possible to place the above record with any species until the specimens have been re-examined.

While this study was being made, Dr. S. F. Hildebrand kindly turned over to me some notes made by Dr. W. H. Longley on types in certain museums of Europe. Though most difficult to read, these proved of considerable value, and it was a pleasure to note that I came to the same conclusions that the late Dr. Longley had independently arrived at in regard to referring certain species to the synonymy of others. Although his notes were never published, some of the conclusions appeared during 1933 and 1934.

The following key was prepared after examining the American clingfishes in the collections of the United States National Museum, as well as specimens lent by the Chicago Natural History Museum (F. M. N. H.) through the courtesy of Dr. K. P. Schmidt and Mrs. Marion Grey, and others lent by the University of Michigan Museum of Zoology through the courtesy of Dr. Carl L. Hubbs. Dr. C. M. Breder, Jr., of the American Museum of Natural History, kindly allowed me to examine the holotype of *Gobiesow yuma* Nichols.

KEY TO THE GENERA AND SPECIES OF AMERICAN GOBIESOCIDAE

- 1a. Groove between tip of snout and upper lip of premaxillaries extending around front of snout and not forming a convex curve dorsally over tip of snout; width of middle of upper lip narrow, about the same as laterally, and approximately equal to width of pupil; gill membranes attached opposite third to fifth upper pectoral fin rays; axial flap of skin behind pectoral fin with its upper edge attached at midbase of pectoral fin or below midbase; fleshy pad on outer pectoral base present only ventrally, without a free margin posteriorly and enlarged or swollen at lower posterior corner of pectoral fin base; lower first to fifth pectoral rays short, about half length of longest pectoral ray, eighth and ninth much longer than lower pectoral rays; anal rays 6 to 8; dorsal rays 6 or 7 (all rudiments counted as one ray).
- 2a. Incisorlike teeth at front of lower jaw with 4 minute points,<sup>1</sup> these at front of upper jaw mostly conical; each jaw with 1 or 2 inner rows of minute conical teeth; axial flap of skin behind pectoral fin attached at lower part of pectoral fin base; anal origin a little behind a vertical line through dorsal origin; greatest depth of body  $5\frac{1}{2}$  to  $6\frac{1}{4}$ , length of head 3 to  $3\frac{1}{4}$ , greatest width of head  $4\frac{1}{2}$  to 5, length of disk 5 to  $5\frac{1}{2}$ , all in standard length; length of disk about equal to distance from tip of snout to front of disk; pectoral rays about 19 to 21; color when alive green or reddish, with or without light spots (*Acyrtus*, new genus) (Florida Keys and West Indies)-----*Acyrtus rubiginosus* (Poey)
- 2b. Incisorlike teeth at front of lower jaw with smooth tips; middle front teeth of upper jaw conical; teeth in inner rows of both jaws shorter, smaller, and conical; axial flap of skin behind pectoral fin attached opposite middle of pectoral base; greatest depth of body 8 or 9, length of head  $3\frac{1}{2}$  to  $3\frac{3}{4}$ , greatest width of head 5, length of disk  $5\frac{1}{2}$ , all in standard length; anal origin a little in advance of dorsal origin; interorbital space  $3\frac{1}{2}$  in head, eye  $1\frac{1}{2}$  in interorbital space; length of disk about equal to caudal peduncle; lower pectoral rays shorter, second and third from bottom about half length of longest pectoral fin rays; pectoral fin rays about 16 or 17 (*Rimicola* Jordan and Evermann) (Todos Santos Bay, Baja California to Monterey Bay and west coast of Vancouver Island, British Columbia)-----*Rimicola eigenmanni* (Gilbert)
- 1b. Tip of snout formed by premaxillaries, which are much wider at middle of snout than laterally, groove arched dorsally over tip of snout; axial flap of skin behind pectoral fin with its upper edge attached much above midbase of this fin; lower first to seventh pectoral fin rays not shortened, about as long as eighth or ninth from bottom.
- 3a. Anterior teeth of lower jaw trifold incisors, trifold tips usually evident, except middle 2 or 3 sometimes worn off smooth although 1 or 2 of more laterally placed incisors at front of lower jaw always trifold.
- 4a. Gill membrane attached opposite third to fifth pectoral fin rays; front teeth of upper jaw smooth tipped incisors (sometimes flattened-coniform); front of both jaws with 1 or 2 inner rows of small conical teeth behind outer row of enlarged incisorlike teeth, sometimes these inner rows apparently represented by only 2 or 3 teeth; fleshy pad on outer base of pectoral fin with free posterior margin ending a little below attachment of gill membranes; greatest width of head 3, length of head

<sup>1</sup> Sometimes the middle two teeth are worn down nearly smooth, as in the type of *G. beryllinus* Hildebrand and Ginsburg.

2% to 2%, greatest depth of body 5 to 6, length of disk  $3\frac{1}{2}$ , all in standard length; length of disk much greater than distance from tip of snout to front of disk; distance from dorsal origin to midbase of caudal fin contained  $1\frac{1}{2}$  to  $1\frac{1}{4}$  times in snout tip to dorsal origin; anal origin under base of the third or fourth dorsal fin ray; caudal peduncle short, its depth about equal to its length and about 3 times in base of dorsal fin; dorsal fin rays 11 to 13, anal 10 or 11, pectoral 18 to 21 (usually 19 or 20) (*Infratridens*, new genus) (Gulf of California; southern California)----- *Infratridens rhessodon* (Rosa Smith)

- 4b. Gill membranes joined opposite upper edge of pectoral fin base; incisorlike teeth of both jaws with trifid tips, except middle pair or two sometimes smooth-tipped; teeth in both jaws in a single row, lateral 2 to 4 conical and last 1 or 2 sometimes strong canines; outer lower base of pectoral fin with fleshy pad poorly developed and without any trace of a free margin; pelvic fins joined about halfway out fourth to sixth pectoral fin rays and not near base; dermal flap in axile of pectoral fin joins opposite fourth to tenth pectoral fin ray; width of head  $3\frac{1}{2}$  to 6, length of head  $2\frac{3}{4}$  to 5, greatest depth of body 6 to 10 (except in *eos*), length of disk 4 to 6 (except in *eos*), all in standard length; opercular spine not strongly developed and not reaching to rear of head (*Arbaciocsa* Jordan and Evermann).

- 5a. A pair of black spots (more or less ocellate) on back behind head over pectorals usually distinct, each spot well separated; dorsal surface of back in front of dorsal origin variously barred or mottled or dark spotted but without 3 hourglass-shaped large dark blotches. (Species inhabiting waters of the Pacific coast and offshore islands.)

- 6a. Distance from base of last dorsal ray to midcaudal fin base contained  $1\frac{3}{10}$  to  $1\frac{1}{4}$  times in length of dorsal fin base; least depth of caudal peduncle about 1.0 to  $1\frac{1}{2}$  times in length of caudal peduncle (from base of last anal ray to midcaudal fin base); interorbital space longer than length of snout; dermal flap of skin in axis of pectoral fin with its upper edge joined to pectoral fin base opposite fifth to eleventh pectoral ray; dorsal rays 10 or 11 (usually 10), anal rays 7 to 9 (usually 8 or 9); pectoral fin rays 19 or 20; middle teeth of both jaws with trifid tips, middle denticle usually longest on lateral teeth, worn down in adults (Gulf of California)----- *Arbaciocsa humeralis* (Gilbert)

- 6b. Distance from base of last dorsal ray to midcaudal fin base contained 0.75 to 0.9 in length of dorsal fin base; least depth of caudal peduncle 1.6 to 2 times in length of caudal peduncle.

- 7a. Pectoral fin rays 22 to 24 (usually 23); dorsal rays usually 8 (7 to 9), anal 7 or 8 (usually 8); greatest width of head contained  $3\frac{1}{2}$ , length of head  $2\frac{3}{4}$  to  $2\frac{1}{2}$ , in standard length; snout a little longer than width of interorbital space; middle teeth of both jaws with trifid tips (Mazatlán, Mexico).

*Arbaciocsa eos* (Jordan and Gilbert)

- 7b. Pectoral fin rays usually 19 to 21 (rarely 22).

- 8a. Middle incisorlike teeth of both jaws (at least on adults) with smooth tips, the lateral incisors trifid; pectoral fin rays usually about 21; bony ridges on snout weakly developed.

- 9a. Dorsal rays 8 to 10 (usually 9); anal 8 or 9 (usually 8) (Peru)----- *Arbaciocsa pyrrhocincla pyrrhocincla* (Cope)

- 9b. Dorsal rays 8; anal 7 or 8 (Galápagos Islands).

*Arbaciocsa pyrrhocincla truncata* Heller and Snodgrass

- 8b. Middle incisorlike teeth of both jaws usually trifold, seldom worn off smooth even on adults; dorsal rays 6 to 8; anal 6 or 7; pectoral 19 to 21 (usually 19 or 20); bony ridges on upper part of snout rather well developed (Ecuador to Gulf of California)----- *Arbacia rhodospila* (Günther)
- 5b. Three or four large hourglass-shaped dark brown or blackish blotches from in front of dorsal fin to rear of head; a fainter one sometimes on top of head; side of head with four oblique bars and sides of body with dark bars; incisors with trifold tips; dorsal rays 7 to 9; anal 6 to 9 (rarely 6 or 9); pectoral 18 to 23 (West Indies; Guatemala to Brazil)----- *Arbacia fasciata* (Peters)
- 8b. None of the teeth with trifold tips.
- 10a. Middle pair of incisors on both jaws much broader and longer than adjoining pairs; posterolateral teeth small and conical; rims of orbits bony, elevated; opercular spine strongly developed and forming posteriormost tip of head; valvular flap and margin of anterior nostril with its margin finely fringed with short cirri; gill membrane attached at upper anterior edge of pectoral fin base; fleshy pad well developed on outer lower surface of pectoral base, with a free membranous edge posteriorly ending at base of tenth to twelfth pectoral ray; shoulder girdle with a free dermal flap extending dorsally nearly to attachment of gill membrane; anal origin under base of second or third from last dorsal fin ray; disk large, its length about equal to head and contained about 2% to 2% in standard length; anus just behind rear margin of disk; origin of dorsal fin a trifle closer to tip of opercular spine than midcaudal fin base; dorsal rays 10 or 11 (usually 11); anal 8 or 9; pectoral 24 or 25 (*Sicyases* Müller and Troschel).
- 11a. Dorsal origin equidistant between midcaudal fin base and upper edge of gill opening to middle of length of upper pectoral rays; distance from base of last dorsal ray to midcaudal fin base in upper edge of gill opening to dorsal origin 1.80 to 2.35; length of caudal peduncle in snout tip to anal origin 5.50 to 7.36; base of dorsal fin in head 1.90 to 2.40; base of anal fin in head 2.83 to 4.06; base of dorsal fin in snout tip to dorsal origin 3.70 to 4.67; base of anal fin in snout tip to anal origin 6.70 to 8.83 (Chile and Peru).
- Sicyases sanguineus* Müller and Troschel
- 11b. Dorsal origin equidistant between midcaudal fin base and middle of postorbital length of head; base of last dorsal ray to midcaudal fin base in upper edge of gill opening to dorsal origin 1.65; length of caudal peduncle in snout tip to anal origin 5.26; base of dorsal fin in head 1.55; base of anal fin in head 2.14; base of dorsal fin in snout tip to dorsal origin 3.04; base of anal fin in snout tip to anal origin 5.10 (Juan Fernández Island).
- Sicyases hildebrandi*, new species
- 10b. Middle pair of incisors not enlarged, all the incisorlike or conical teeth at front of both jaws of nearly same size and length; front of lower jaw with small incisors in 2 or 3 pairs, with smooth tips; posterolateral teeth smaller, conical, sometimes one or two a little enlarged and almost caninelike; usually a small patch of very short conical teeth behind outer row of larger teeth at front of jaws but sometimes lacking or reduced to 1 or 2 teeth; rims of orbits not elevated or bony; anterior nostril with a dermal flap, sometimes with bifid or even

multifid tips arising on posterior rim, but nostrils not fringed with short cirri.

- 12a. Short blunt papillae on lips and around mouth generally, these in form of short barblets, arrangement as follows: Median part of chin and lower jaw with 2 or 3 rows of papillae, or chin anteriorly with a pair of low lobes in form of reversed parentheses [ ) ( ] and sometimes at their inner tips a pair of papillae (more or less fused with anterior lobes in *nigripinnis* and in *pinniger*); an inner row of barblets lateral to median lobes, one pair on each side; lower lip at each side of median part of chin lobelike, sometimes bearing 2 small papillae; along inner edge of groove of lower jaw are 2 or 3 large papillae or knobs on each side; upper lip with a median papilla or knob and 5 more on each side; front edge of snout above groove without papillae but laterally 3 to 5 knobs or papillae present or absent; sometimes another papilla occurring behind rictus and still another below rictus; gill membranes joined opposite fifth to seventh upper rays of pectoral fin; fleshy pad on outer base of pectoral fin with a free posterior membranous margin extending dorsally to opposite attachment of gill membranes; dorsal rays 10 to 19; pectoral fin rays 21 to 27; anus closer to anal origin than to rear margin of disk (*Cotylin* Müller and Troschel).
- 13a. Dorsal rays fewer than 15, counting all rudiments.
- 14a. Dorsal rays 13 or 14; anal 10; upper lip with papillae.
- 15a. Pectoral fin rays 22; papillae around mouth short and knoblike (Gulf of California)-----*Cotylin papillifer* (Gilbert)
- 15b. Pectoral fin rays 24 to 27; papillae around mouth more numerous, better developed, barbellike; lobe of lower lip next to middle of chin with two barbels (pl. 1, A) (Panama Bay to Ecuador and northern Peru)---*Cotylin microspilus* (Fowler)
- 14b. Dorsal rays 10 to 12; anal 8 to 10; papillae on upper lip, lobelike; lobe of lower lip next to middle of chin without barbels (pl. 1, B); dorsal origin equidistant between midbase of caudal fin and middle of postorbital length of head to equidistant between midcaudal base and upper base of pectoral fin; color pattern variable; median fins mottled, barred, or blackish with tips of rays white.
- 16a. Depth  $4\frac{1}{2}$  to  $6\frac{1}{2}$ ; eye 3.1 to 3.6 in length of base of dorsal fin; dorsal rays usually 11, anal usually 9, pectoral 22 to 26 (Maryland to West Indies to Brazil).
- Cotylin nigripinnis nigripinnis* Peters
- 16b. Depth about  $6\frac{1}{2}$  or 7; eye 2.8 in length of dorsal fin base; dorsal rays 10, anal 8, pectoral 22 (Cocos Island).
- Cotylin nigripinnis woodsi*, new subspecies
- 18b. Dorsal rays 17 to 19 (counting all rudiments); anal 10; anal origin under base of ninth or tenth dorsal fin ray or under middle of base of dorsal fin; origin of dorsal fin a little closer to tip of snout than midbase of caudal fin; papillae on upper lip knoblike (Gulf of California)-----*Cotylin pinniger* (Gilbert)
- 12b. No papilla on upper lip, lobelike structures occurring around lips of lower jaw when best developed being low knobs or ridges, chin lacking inner series of papillae as described for *Cotylin*.
- 17a. Gill membranes joined at upper edge of pectoral fin base, sometimes a little anteriorly, giving appearance of being opposite

bases of upper first to third pectoral fin rays or the orbits larger than interorbital space; incisorlike teeth at front of lower jaw projecting forward in a nearly horizontal or oblique direction, middle pair a little larger than those laterally.

- 18a. Anal rays 10 to 14; dorsal 12 to 16, pectoral 19 to 23 (counting all rudiments); fleshy pad on outer margin of pectoral fin base very well developed and free membranous border along its posterior edge extending up to or beyond twelfth pectoral ray from dorsal edge; interorbital space equal to or wider than eye; least depth of caudal peduncle  $4\frac{1}{2}$  to  $5\frac{1}{4}$  times in dorsal origin to midcaudal fin base; anal origin under anterior third of dorsal fin base (*Sicyogaster* Brisout de Barneville).

- 19a. Anal rays 10 or 11; dorsal 12 or 13; free margin of fleshy pad on pectoral fin base ending abruptly opposite ninth to twelfth ray from upper edge of pectoral fin base; eye 1 to  $1\frac{1}{2}$  in interorbital space and 4 or 5 in head; anus a little closer to rear margin of disk than to anus; origin of dorsal fin equidistant between midbase of caudal fin and anterior half of postorbital length of head (Peru and Chile).

*Sicyogaster marmoratus* (Jenyns)

- 19b. Anal rays 12 to 14; dorsal 13 to 16; fleshy pad on outer base of pectoral fin with free posterior margin ending gradually, about opposite first to third upper pectoral fin ray; eye  $1\frac{1}{2}$  to 2 in interorbital space; length of disk about 3, head about  $2\frac{1}{2}$ , greatest depth  $4\frac{1}{2}$  to 5, all in standard length; anus much closer to anal origin than rear margin of disk; origin of dorsal fin equidistant between midbase of caudal fin and rear of head; interorbital space about equal to snout (San Diego to Queen Charlotte Islands, British Columbia; Puget Sound)----- *Sicyogaster maeandricus* (Girard)

- 18b. Anal rays 7 or 8; dorsal 7 to 9; pectoral 22 to 25; diameter of eyes greater than interorbital space, the latter about  $\frac{3}{4}$  to  $\frac{1}{2}$  in eye; color usually reddish when alive (*Arcos*, new genus).

- 20a. Free margin of fleshy pad on pectoral fin base ending opposite thirteenth ray from upper edge of pectoral fin base; interorbital space 6 or 7 in head; least depth of caudal peduncle  $3\frac{1}{2}$  times in distance from midcaudal fin base to dorsal origin and  $1\frac{1}{2}$  in its length; pelvics fastened nearer base of pectoral rays than one-third way out (Galápagos Islands; Panama Bay; and Mazatlán, Gulf of California).

*Arcos poecilophthalmus* (Jenyns)

- 20b. Free margin of fleshy pad on pectoral fin base ending opposite sixteenth to nineteenth ray from upper edge of pectoral fin base; interorbital 5 or 6 times in head; least depth of caudal peduncle 4 times in distance from midcaudal base to dorsal origin and  $1\frac{1}{2}$  in its length; pelvics fastened about one-third way out lower pectoral rays (Bahama Islands; West Indies).

*Arcos macropthalmus* (Günther)

- 17b. Gill membranes joined opposite third to seventh upper pectoral fin rays somewhat more anteriorly than in *Cottus*; incisorlike teeth at front of lower jaw not projecting horizontally forward but curved obliquely upward so as to nearly oppose those in upper jaw, the pair of incisors at middle of lower jaw nearly same size as adjoining ones; outer surface of pectoral fin base with a dis-

tinctly fleshy pad, posterior margin free and joined opposite attachment of gill membranes (*Gobiesox* Lacepède).

21a. Disk much greater than distance from tip of chin to front of disk.

22a. Origin of dorsal fin equidistant between midcaudal fin base and rear one-third of pectoral fin rays or a little behind them; anal origin under fifth dorsal fin ray, behind middle of base of rays of that fin; teeth of lower jaw not projecting forward in a nearly horizontal position but directed nearly straight upward in adults, a little more oblique in young specimens; head 2.2 to 2.7, disk 2.6 to 3.3, and depth 4 to 5.5, all in standard length; dorsal rays 8 or 9, anal 5 to 7, pectoral 18 to 21; anus equidistant between anal origin and rear margin of disk or a little nearer to anal origin; eye  $1\frac{1}{2}$  (young) to 5 (adults) times in interorbital space.

23a. Length of disk when measured from its rear margin reaches nearly to end of anal fin usually from midbase to base of last anal ray; small dark spot often present near front of base of dorsal fin (Costa Rica, West Indies, to Brazil).

*Gobiesox cephalus* Lacepède

23b. Length of disk when measured from its rear margin reaches only to base of first or second anal fin ray; front of dorsal with a large dark blotch not at base of fin (Cocos Island).

*Gobiesox fulvus* Meek

22b. Dorsal origin equidistant between midcaudal fin base and upper base of pectoral fin or rear of head; dorsal rays 10 or 11, anal 8, pectoral 19 to 21; gill membrane attached opposite fourth to seventh upper pectoral fin rays; interorbital  $3\frac{1}{2}$  to  $4\frac{1}{2}$  in head; distance from base of last dorsal ray to midcaudal base  $2\frac{1}{4}$  to  $3\frac{1}{4}$  times in distance from dorsal origin to rear of head; anus equidistant between or closer to anal origin than rear margin of disk; fleshy pad on pectoral fin base with posterior margin free all way up to attachment of gill membrane; anal origin under fifth dorsal ray; depth of caudal peduncle equals its length.

24a. Eye  $1\frac{1}{2}$  to 2 in interorbital space (Texas; British Honduras; Bahamas and West Indies). *Gobiesox punctulatus* (Poey)

24b. Eye 0.9 to 1.1 in interorbital space (Pacific-Mazatlán).

*Gobiesox adustus* Jordan and Gilbert

21b. Disk about equal to distance from tip of chin to front of disk; pelvic fins attached about one-third way out pectoral fin rays; length of disk equal to distance from rear margin of disk to anus or  $1\frac{1}{2}$  times from disk to anal origin; head 2.9, disk 3.8 to 4.2, depth 5 or 6, width of head  $3\frac{1}{2}$ , all in standard length; eye  $1\frac{1}{2}$  to 2 in interorbital space; interorbital  $3\frac{1}{2}$  and disk  $1\frac{1}{2}$  in head; dorsal origin equidistant from midcaudal fin base and middle of length of pectoral fin; distance from last dorsal ray to midcaudal fin base 4 times in distance from rear of head to dorsal origin; anus closer to anal origin than rear margin of disk; least depth of caudal peduncle greater than length of caudal peduncle from base of last anal ray to midcaudal fin base; opercular spine not well developed; anal origin under base of about the sixth dorsal ray; dorsal rays 11 or 12; anal 7 or 8; pectoral 18 to 20 (Gulf of California).

*Gobiesox funebris* Gilbert





## ACYRTUS, new genus

*Genotype*.—*Sicyases rubiginosus* Poey.

This new genus is characterized by the lack of a dorsal curve of the premaxillary groove along upper lip over the snout tip in conjunction with the incisorlike teeth of the lower jaw having four minute joints. It may be distinguished from all other genera of American Gobiessocidae by the key on page 49. Other characters are those of the genotype.

Named *Acyrtus* in reference to the absence of the dorsal curve of the premaxillary groove over front of snout so common in all other American clingfishes except *Rimicola*, to which this new genus is most closely related.

## ACYRTUS RUBIGINOSUS (Poey)

*Sicyases rubiginosus* POEY, Synopsis piscium Cubensium, p. 391, 1868 (Palmasola, Cuba); Enumeratio piscium Cubensium, p. 124, 1876 (Cuba).—JORDAN, EVERMANN, and CLARK, Rep. U. S. Comm. Fish. for 1928, pt. 2, p. 490, 1930 (Matanzas, Cuba).

*Sicyases carneus* POEY, Synopsis piscium Cubensium, p. 392, 1868 (Palmasola, Cuba); Enumeratio piscium Cubensium, p. 124, 1876 (Cuba).—JORDAN, EVERMANN, and CLARK, Rep. U. S. Comm. Fish. for 1928, pt. 2, p. 490, 1930 (Matanzas, Cuba).

*Sicyases carneus* Poey = *S. rubiginosus* Poey, LONGLEY, Carnegie Inst. Washington Year Book, No. 33, p. 271, 1934.

*Arbaciola* sp. BEEBE and TEE-VAN, Zoologica, vol. 10, No. 1, p. 252, 1928 (Lamentin Reef, Port-au-Prince Bay, Haiti).

*Gobiesox rubiginosus* JORDAN and EVERMANN, Rep. U. S. Comm. Fish and Fish. for 1895, App., p. 492, 1896 (Matanzas, Cuba); U. S. Nat. Mus. Bull. 47, pt. 3, p. 2337, 1898 (Cuba).

*Gobiesox carneus* JORDAN and EVERMANN, Rep. U. S. Comm. Fish and Fish. for 1895, App., p. 492, 1896 (Matanzas, Cuba); U. S. Nat. Mus. Bull. 47, pt. 3, p. 2337, 1898 (Matanzas).

*Gobiesox (Rimicola) beryllinus* HILDEBRAND and GINSBURG, Bull. U. S. Bur. Fish., vol. 42, p. 213, fig. 5, 1927 (Key West, Boca Chica, Fla.).

*Rimicola beryllinus* JORDAN, EVERMANN, and CLARK, Rep. U. S. Comm. Fish. for 1928, pt. 2, p. 490, 1930 (Key West).

*Remarks*.—An examination of the type of *beryllinus* indicates that the incisorlike teeth at the front of the lower jaw have four minute points, although the middle ones are worn down a little. The teeth along with other characters in the description of *beryllinus* are in need of rechecking, but the type appears to have been dried out sometime and is not in first-class condition. Hildebrand and Ginsburg's drawing, "figure 5," has the lower rays of the pectoral fin twice too long and the disk is not quite long enough. The fin rays were not correctly counted in the original description.

*Material examined*.—CUBA: U.S.N.M. Nos. 82581 and 82582, totaling 12 specimens. FLORIDA: U.S.N.M. Nos. 87533 (holotype of *beryllinus*) and 116936, one specimen.

*Range*.—Florida Keys and West Indies.

Genus RIMICOLA Jordan and Evermann

*Rimicola* JORDAN and EVERMANN, in Jordan, Proc. California Acad. Sci., vol. 6, p. 231, 1896. (Genotype: *Gobiesox muscarum* Meek and Pierson [= *Gobiesox eigenmanni* Gilbert].)

RIMICOLA EIGENMANNI (Gilbert)

*Gobiesox eigenmanni* GILBERT, Proc. U. S. Nat. Mus., vol. 13, p. 96, 1890 (Point Loma, near San Diego, Calif.).

*Gobiesox rhessodon* ROSA SMITH, Proc. U. S. Nat. Mus., vol. 7, p. 553, 1885 (San Cristóbal, Baja California).

*Rimicola eigenmanni* JORDAN, Proc. California Acad. Sci., vol. 6, p. 231, pl. 32, 1896.—JORDAN and EVERMANN, Rep. U. S. Comm. Fish and Fish. for 1895, App., p. 492, 1896 (Point Loma); U. S. Nat. Mus. Bull. 47, pt. 3, p. 2339, 1898 (Point Loma, San Cristóbal Bay).—SNYDER, Proc. U. S. Nat. Mus., vol. 35, p. 183, 1908 (Todos Santos Bay, Baja California, northward to Pacific Grove, Calif.).—JORDAN, EVERMANN, and CLARK, Rep. U. S. Comm. Fish. for 1928, pt. 2, p. 490, 1930 (Point Loma to Monterey).—WILBY, Copela, 1936, No. 2, p. 116 (Round Island Flats, Clayoquot Sound, British Columbia).

*Rimicola muscarum* JORDAN, Proc. California Acad. Sci., vol. 6, p. 231, 1896.—JORDAN and EVERMANN, Rep. U. S. Comm. Fish and Fish. for 1895, App., p. 492, 1896 (Monterey Bay); U. S. Nat. Mus. Bull. 47, pt. 3, p. 2338, 1898 (Monterey Bay).

*Gobiesox muscarum* MEEK and PIERSON, Proc. California Acad. Sci., vol. 5, p. 571, pl. 71, 1895 (Monterey Bay, Calif.).

*Remarks.*—My counts appear to disagree with those made by Snyder, Wilby, and other authors because I have included all the rudimentary fin rays at the beginning of each fin, apparently not counted previously. To be certain of my fin ray counts, the skin was dissected away from one side of each fin at the base of the anterior fin rays. This revealed usually one or sometimes two rudimentary fin rays, and thus the counts by Snyder and by Wilby should be increased by one or two to bring them into line with my counts.

*Material examined.*—BRITISH COLUMBIA (Vancouver Island): U.S.N.M. No. 53850. CALIFORNIA: U.S.N.M. Nos. 44372 (holotype of *eigenmanni*), 48875 (cotype of *muscarum*), 49570, and 61055; U.M.M.Z. Nos. 64260, 64261, 64262, 63648, 63646, 63647, totaling 17 specimens.

*Range.*—Todos Santos Bay, Baja California, to Monterey Bay, and west coast of Vancouver Island.

INFRATRIDENS, new genus

*Genotype.*—*Gobiesox rhessodon* Rosa Smith.

This new genus may be recognized from all other genera of Gobiesocidae by the characters described in the key on pages 49–50. It is distinguished by its trifid incisorlike teeth at front of lower jaw, the smooth-tipped teeth in upper jaw, and the convex premaxillary groove across front of snout. Other characters are those of the genotype.

Named *Infratridens* in reference to the trifid teeth at front of lower jaw.

**INFRATRIDENS RHESSODON (Rosa Smith)**

*Gobiesox rhesodon* ROSA SMITH, in Jordan and Gilbert, Proc. U. S. Nat. Mus., vol. 4, p. 63, 1881 (Point Loma) (*nomen nudum*).—ROSA SMITH, Proc. U. S. Nat. Mus., vol. 4, p. 140, 1881 (San Diego, Calif.).

*Arbaciola rhesodon* JORDAN, Proc. California Acad. Sci., vol. 6, p. 230, pl. 36, 1896.—JORDAN and EVERMANN, Rep. U. S. Comm. Fish and Fish. for 1895, App., p. 492, 1896 (San Diego; Gulf of California); U. S. Nat. Mus. Bull. 47, pt. 3, p. 2340, 1898 (San Diego; Gulf of California).—JORDAN, EVERMANN, and CLARK, Rep. U. S. Comm. Fish. for 1928, pt. 2, p. 490, 1930 (San Diego; Gulf of California).

*Material examined*.—CALIFORNIA: U.S.N.M. Nos. 5246, 28396 (3 types of *rhesodon*), 34765, 41975, 49574, 67312, 104193, 117642, totaling 24 specimens; U.M.M.Z. Nos. 63650, 63653, 63651, 63649, 63652, totaling 69 specimens. CATALINA ISLAND: U.S.N.M. No. 121964 and U.M.M.Z. No. 64263, totaling 8 specimens. BAJA CALIFORNIA: U.S.N.M. Nos. 36948 and 79149, totaling 2 specimens.

*Range*.—Southern California to Baja California.

**Genus ARBACIOSA Jordan and Evermann**

*Arbaciola* JORDAN and EVERMANN, in Jordan, Proc. California Acad. Sci., vol. 6, p. 230, 1896. (Genotype: *Gobiesox humeralis* Gilbert.)

**ARBACIOSA HUMERALIS (Gilbert)**

*Gobiesox humeralis* GILBERT, Proc. U. S. Nat. Mus., vol. 13, p. 95, 1890 (Puerto Refugio, Ángel Island).—PELLEGRIN, Bull. Mus. Hist. Nat. Paris, vol. 7, p. 162, 1901 (Gulf of California).

*Arbaciola humeralis* JORDAN, Proc. California Acad. Sci., vol. 6, p. 230, pl. 35, 1896.—JORDAN and EVERMANN, Rep. U. S. Comm. Fish and Fish. for 1895, App., p. 491, 1896 (Gulf of California); U. S. Nat. Mus. Bull. 47, pt. 3, p. 2341, 1898 (Ángel Island; La Paz).—JORDAN, EVERMANN, and CLARK, Rep. U. S. Comm. Fish. for 1928, pt. 2, p. 490, 1930 (Gulf of California).

*Material examined*.—GULF OF CALIFORNIA: U.S.N.M. Nos. 44374 (cotype of *humeralis*), 125008 (cotype of *humeralis*), 46693, 48259 (4 cotypes of *humeralis*), totaling 8 specimens; F.M.N.H. No. 3336, 44 specimens; U.M.M.Z. No. 136128, 1 specimen.

*Range*.—Gulf of California.

**ARBACIOSA EOS (Jordan and Gilbert)**

*Gobiesox eos* JORDAN and GILBERT, Proc. U. S. Nat. Mus., vol. 4, p. 360, 1882 (Mazatlán).

*Arbaciola eos* JORDAN, Proc. California Acad. Sci., vol. 6, p. 230, pl. 37, 1896 (Mazatlán).—JORDAN and EVERMANN, Rep. U. S. Comm. Fish and Fish. for 1895, App., p. 491, 1896 (Pacific coast of Mexico); U. S. Nat. Mus. Bull. 47, pt. 3, p. 2343, 1898 (Mazatlán).—JORDAN, EVERMANN, and CLARK, Rep. U. S. Comm. Fish. for 1928, pt. 2, p. 491, 1930 (Pacific coast of Mexico).

*Material examined*.—MEXICO (Mazatlán): U.S.N.M. No. 30889 (18 cotypes of *Gobiesox eos*), C. H. Gilbert.

*Range*.—Mazatlán, Mexico.

**ARBACIOSA PYRRHOCINCLA PYRRHOCINCLA (Cope)**

- Sicyases pyrrhocinclus* COPE, Proc. Amer. Philos. Soc., vol. 17, p. 43, 1877 (Peru).  
*Arbaciosa pyrrhocinclus* ABBOTT, Proc. Acad. Nat. Sci. Philadelphia, 1899, p. 363 (Peru, Pecosmayu Bay ?).—EVERMANN and RADCLIFFE, U. S. Nat. Mus. Bull. 95, p. 155, 1917.  
*Arbaciosa hieroglyphica* EVERMANN and RADCLIFFE, U. S. Nat. Mus. Bull. 95, p. 155, pl. 14, fig. 2, 1917 (Lobos de Afuera, Peru).  
 ? *Arbaciosa petersii* (non Garman) ABBOTT, Proc. Acad. Nat. Sci. Philadelphia, 1899, p. 363 (Peru) [not based on any specimen].  
 ? *Gobiosæ zebra* (non Jordan and Gilbert) REGAN, Ann. Mag. Nat. Hist., ser. 8, vol. 12, p. 280, 1933 (Lobos de Tierra, Peru).

*Material examined*.—PERU (Lobos de Afuera Islands): U.S.N.M. Nos. 77561 (type of *hieroglyphica*), 77565 (10 cotypes of *hieroglyphica*), 101703, 101704, 101705, 128175, totaling 21 specimens. Also from PERU: U.S.N.M. Nos. 88817, 88827, 88828, 119753, 128174, totaling 19 specimens.

*Range*.—Peru.

**ARBACIOSA PYRRHOCINCLA TRUNCATA Heller and Snodgrass**

- Arbaciosa truncata* HELLER and SNODGRASS, Proc. Washington Acad. Sci., vol. 5, p. 216, pl. 14, 1903 (Tagus Cove, Albemarle Island, Galápagos).—KENDALL and RADCLIFFE, Mem. Mus. Comp. Zool., vol. 35, No. 3, p. 160, 1912 (Chatham Island).—HERRE, Publ. Field Mus. Nat. Hist., zool. ser., vol. 21, p. 391, 1936 (South Seymour Island; Eden Island).  
*Gobiosæ zebra* (non Jordan and Gilbert) GILBERT, Proc. U. S. Nat. Mus., vol. 13, p. 452, 1890 (Duncan Island, Galápagos).

*Material examined*.—GALÁPAGOS ISLANDS: U.S.N.M. Nos. 65427, 101702, 101710, 101715, 101716, 101718, 109419, 116202, 119337, totaling 36 specimens; F.M.N.H. Nos. 25165–25215, 41301–41303, 41214, 41215, 41641–41646, totaling 62 specimens.

*Range*.—Galápagos Islands.

**ARBACIOSA RHODOSPILA (Günther)**

- Gobiosæ rhodospius* GÜNTHER, Proc. Zool. Soc. London, vol. 6, p. 25, 1864 (Panama); Trans. Zool. Soc. London, vol. 6, pp. 390, 445, 1869 (Panama).—JORDAN and EVERMANN, Rep. U. S. Comm. Fish and Fish. for 1895, App., p. 492, 1896 (Panama); U. S. Nat. Mus. Bull. 47, pt. 3, p. 2335, 1898 (Panama).—BOULENGER, Bol. Mus. Zool. Anat. Comp. Univ. Torino, vol. 14, No. 335, p. 8, 1899 (Santa Elena Bay, Ecuador).—GILBERT and STARKS, Mem. California Acad. Sci., vol. 4, p. 189, 1904 (Panama).—MEEK and HILDEBRAND, The marine fishes of Panama, pt. 3, p. 926, 1928 (Panama and Santa Elena Bay).—JORDAN, EVERMANN, and CLARK, Rep. U. S. Comm. Fish. for 1928, pt. 2, p. 489, 1930 (Panama).  
*Sicyases petersii* GARMAN, Proc. Boston Soc. Nat. Hist., vol. 18, p. 203, 1875 (San José, San Miguel, and Saboga, all Pearl Islands, Panama Bay).  
*Gobiosæ zebra* JORDAN and GILBERT, Proc. U. S. Nat. Mus., vol. 4, p. 359, 1882 (Mazatlán).

*Arbacirosa zebra* JORDAN and EVERMANN, Rep. U. S. Comm. Fish and Fish. for 1895, App., p. 408, 1896 (Mazatlán); U. S. Nat. Mus. Bull. 47, pt. 3, p. 2341, 1898, (Mazatlán).—MEEK and HILDEBRAND, Marine fishes of Panama, pt. 3, p. 927, 1928 (Toboguilla Island).—KENDALL and RADCLIFFE, Mem. Mus. Comp. Zool., vol. 35, No. 3, p. 160, 1912 (Toboguilla Island).—JORDAN, EVERMANN, and CLARK, Rep. U. S. Comm. Fish. for 1928, pt. 2, p. 491, 1930 (Mazatlán.)

*Material examined*.—GULF OF CALIFORNIA: U.S.N.M. Nos. 29250 (47 cotypes of *zebra*), 47496, 119716, 119717, 119754, totaling 56 specimens. COSTA RICA: U.S.N.M. Nos. 92119 and 101711, totaling 3 specimens. PANAMA BAY: U.S.N.M. Nos. 65428 and 120435 (3 cotypes of *petersii*), totaling 8 specimens. COLOMBIA: U.S.N.M. No. 101712, one specimen. ECUADOR: U.S.N.M. Nos. 88826 and 101717, totaling 3 specimens.

*Range*.—Gulf of California to Ecuador.

#### ARBACIOSA FASCIATA (Peters)

*Sicyases fasciatus* PETERS, Monatsb. Akad. Wiss. Berlin, 1859, p. 412, May 8, 1860 (Puerto Cabello [probably Venezuela]).—GÜNTHER, Catalogue of the fishes in the British Museum, vol. 3, p. 497, 1861 (Puerto Cabello); Trans. Zool. Soc. London, vol. 6, p. 390, 1869 (Puerto Cabello).—GÜTTIG, Arch. Zool. Exper., vol. 5, No. 5, pp. 645–652, 1906 (anatomy).—JORDAN, EVERMANN, and CLARK, Rep. U. S. Comm. Fish. for 1928, pt. 2, p. 490, 1930 (Puerto Cabello).

*Gobiesox rupestris* POEY, Memorias sobre la historia natural de la isla de Cuba, vol. 2, p. 283, pl. 18, fig. 6, July 1860.

*Gobiesox fasciatus* JORDAN and EVERMANN, Rep. U. S. Comm. Fish and Fish. for 1895, App., p. 492, 1896 (Puerto Cabello); U. S. Nat. Mus. Bull. 47, pt. 3, p. 2338, 1898 (Puerto Cabello).

*Arbacirosa rupestris* JORDAN and EVERMANN, Rep. U. S. Comm. Fish and Fish. for 1895, App., p. 492, 1896 (Cuba); U. S. Nat. Mus. Bull. 47, pt. 3, p. 2341, 1898 (Cuba).—BEEBE and TEE-VAN, Zoologica, vol. 10, No. 1, p. 252, fig., 1928 (Port-au-Prince Bay, Haiti).—JORDAN, EVERMANN, and CLARK, Rep. U. S. Comm. Fish. for 1928, pt. 2, p. 491, 1930 (Cuba).—PARR, Bull. Bingham Oceanogr. Coll., vol. 3, art. 4, p. 136, 1930 (Green Cay, Bahamas).

*Sicyases rupestris* POEY, Synopsis piscium Cubensium, p. 391, 1868 (Cuba); Enumeratio piscium Cubensium, pt. 2, p. 124, 1876 (Cuba).

*Arbacirosa minuta* MEEK and HILDEBRAND, The marine fishes of Panama, pt. 3, p. 928, pl. 92, 1928 (Colon, Panama).

*Material examined*.—ST. CROIX ISLAND: U.S.N.M. Nos. 15382 and 15431, totaling 13 specimens. BARBADOS: U.S.N.M. No. 86752, 1 specimen. CUBA: U.S.N.M. Nos. 37414, 37421, 82580, totaling 15 specimens. GUATEMALA: U.M.M.Z. Field No. H35–138a, 6 specimens. PANAMA: U.S.N.M. No. 81523 (type of *minuta*). BRAZIL: U.S.N.M. Nos. 87799, 87800–87803, 88042, totaling 19 specimens.

*Range*.—West Indies; Guatemala to Brazil.

#### Genus SICYASES Müller and Troschel

*Sicyases* MÜLLER and TROSCHER, in Müller, Arch. für Naturg. (Wiegmann), 9th year, vol. 1, pp. 297, 298, 1843 (genotype: *Sicyases sanguineus* Müller and Troschel); Ber. Verh. preuss. Akad. Wiss., 1843, p. 212 (genotype: *Sicyases sanguineus* Müller and Troschel) (ref. copied); Horae Ichthyologicae. Beschreibung und abbildung neuer Fische, pt. 3, p. 19, 1849.

*Tomicodon* BRISOUT DE BARNEVILLE, Rev. Zool. Soc. Cuv., vol. 9, p. 144, 1846 (*Tomicodon chilensis* Brisout de Barneville); Echo Monde Savant, vol. 13, p. 535, 1846.

**SICYASES SANGUINEUS Müller and Troschel**

*Sicyases sanguineus* MÜLLER and TROSCHER, in Müller, Arch. für Naturg. (Wiegmann), 9th year, vol. 1, p. 298, 1843 (Chile); Horae ichthyologicae, pt. 3, p. 19, pl. 3, fig. 1, 1849 (Chile).—GÜNTHER, Catalogue of the fishes in the British Museum, vol. 3, p. 494, 1861 (Chile; Valparaiso).—DELFIN, Catálogo de los peces de Chile, Valparaiso, p. 90, 1901 (Bahía de Concepción; Cavancha; Isla de Juan Fernández; Tomé; Talcahuano).

*Tomicodon chilensis* BRISOUT DE BARNEVILLE, Rev. Zool. Soc. Cuv., vol. 9, p. 144, 1846 (Valparaiso).

? *Gobiesox brevirostris* GAY, Historia física y política de Chile . . . Zoologia, vol. 2, p. 335, pl. 9, fig. 1, 1848 (ref. copied).

*Gobiesox sanguineus* ABBOTT, Proc. Acad. Nat. Sci. Philadelphia, 1899, p. 363, (coasts of Peru and Chile).—EVERMANN and RADCLIFFE, U. S. Nat. Mus. Bull. 95, p. 153, 1917 (Peru and Chile).

*Sicyases chilensis* GÜNTHER, Catalogue of the fishes in the British Museum, vol. 3, p. 497, 1861 (Valparaiso).—DELFIN, Catálogo de los peces de Chile, Valparaiso, p. 90, 1901 (Valparaiso).

*Material examined*.—PERU: U.S.N.M. Nos. 44130, 77512, 83029, 91557, totaling 11 specimens. CHILE (Valparaiso): U.S.N.M. No. 121950 and F.M.N.H. No. 32994, 1 specimen each number.

*Range*.—Peru and Chile.

**SICYASES HILDEBRANDI, new species**

*Holotype*.—U.S.N.M. No. 88818, the only known specimen, 69 mm. in standard length, collected by Dr. W. L. Schmitt at Cumberland Bay, Juan Fernández Island, off Chile, December 1926.

*Description*.—Certain measurements were made on the holotype, and these along with others made on three specimens of *S. sanguineus* are recorded in table 2.

The following counts were made on the holotype: Dorsal rays 11; anal rays 9; pectoral rays 25–25; free edge of pectoral pad ends opposite 11–11 pectoral rays counting down from the dorsal edge; gill membranes attached opposite upper edge of pectoral fin base.

Head about  $3\frac{1}{2}$ , depth 6.9, disk 2.9, all in standard length; eye  $1\frac{1}{2}$  in interorbital space, the latter  $2\frac{2}{3}$  in head (to upper edge of gill opening); dorsal origin equidistant between midcaudal fin base and middle of postorbital length of head; anal origin under bases of second and third from last dorsal fin rays; tip of snout to tip of opercular spine equal to distance from upper edge of gill opening to dorsal origin; base of last dorsal ray to midcaudal fin base  $1\frac{1}{2}$  in upper edge gill opening to dorsal origin; base of dorsal fin  $1\frac{1}{10}$  and base of anal fin 2.1, both in gill opening to dorsal origin; anus just behind the rear margin of the disk; free posterior margin of the

fleshy pad on lower pectoral base ending opposite the eleventh ray from dorsal edge of pectoral fin; the middle incisors of both jaws much wider than the adjoining pair and those on lower jaw longer, but the two middle pairs of upper jaw about the same length; the interorbital space slightly concave; both nostrils close in front of eye, the anterior one with a small fringed flap arising on its posterior edge.

TABLE 2.—*Measurements of the two species of Sicyases, in hundredths of the standard length*

Characters	<i>hildebrandi</i>	<i>sanguineus</i>			
	Holotype	U.S.N.M. Nos.			
		77512	77512	77512	83029
Standard length (in millimeters).....	69	59	78.5	90	159
Length of head to upper edge of gill opening.....	28.3	32.2	33.8	35.3	37.1
Length of head to tip of opercular spine.....	33.3	35.6	37.6	33.3	44.3
Greatest depth of body.....	14.5	14.9	15.9	16.1	21.7
Greatest width of head.....	27.5	29.1	29.9	33.9	37.1
Least depth of caudal peduncle.....	7.82	8.30	7.77	8.33	7.86
Length of caudal peduncle.....	13.8	13.9	10.8	11.1	13.8
Length of snout.....	10.6	11.7	12.2	13.1	13.8
Diameter of eye.....	7.54	7.63	8.02	7.56	6.25
Width of bony interorbital.....	12.2	12.2	14.0	16.0	18.2
Postorbital length of head to upper edge of gill opening.....	14.9	16.4	16.7	17.2	20.4
Postorbital length of head to tip of opercular spine.....	19.1	20.2	21.9	23.3	28.0
Length of disk.....	35.6	36.4	38.8	40.6	45.9
Distance from base of last dorsal ray to midcaudal base.....	21.7	20.7	17.5	19.1	16.0
Disk to anus.....	3.91	3.90	4.20	3.67	0.94
Anus to anal origin.....	19.6	23.4	20.4	21.6	20.4
Snout tip to dorsal origin.....	59.4	62.7	66.2	68.4	69.2
Snout tip to anal origin.....	72.5	76.3	79.7	80.0	80.5
Snout tip to center of anus.....	52.6	53.2	58.1	57.2	59.2
Length of base of dorsal fin.....	19.5	17.0	15.5	14.7	17.9
Length of base of anal fin.....	14.2	11.4	9.30	10.0	9.12
Longest ray of dorsal fin.....	12.5	12.2	12.5	13.3	14.1
Longest ray of anal fin.....	11.7	11.2	11.5	11.7	-----
Longest ray of caudal fin.....	24.5	23.6	-----	23.5	22.0
Longest ray of pectoral fin.....	14.5	15.3	14.3	16.7	18.2
Tip of snout to disk.....	13.3	14.2	14.3	15.5	15.4
Origin of dorsal to upper edge of gill opening.....	36.0	37.3	37.6	38.6	37.7

*Remarks.*—The chief differences between this new species and *Sicyases sanguineus* are in the more anterior position of the dorsal fin and the length of the bases of the dorsal and anal fins. The following measurements indicate the amount of the above differences, first for the new species then for *sanguineus*: Distance from base of last dorsal ray to midcaudal fin base in upper edge of gill opening to dorsal origin 1.65 and 1.80–2.35; length of caudal peduncle in tip of snout to anal origin 5.26 and 5.50–7.36; base of dorsal fin in head 1.55 and 1.90–2.40; base of anal fin in head 2.14 and 2.83–4.06; base of dorsal fin in snout to

dorsal origin 3.04 and 3.70–4.67; base of anal fin in snout to anal origin 5.10 and 6.70–8.83; dorsal origin equidistant between midcaudal fin base and middle of postorbital length of head for *hildebrandi*, and upper edge of gill opening to middle of length of upper pectoral rays for *sanguineus*. In general, the new species appears to be a little slenderer than *sanguineus*. Presumably, when an adequate series of *hildebrandi* is collected from the Juan Fernández Islands and studied, this new species may be best treated as a subspecies of *sanguineus*.

Named *hildebrandi* for Dr. Samuel F. Hildebrand, senior ichthyologist, United States Fish and Wildlife Service, who while working up a monograph of the fishes of Peru noticed this new fish and suggested that I describe it. It is with great pleasure that I name this new species in his honor and in recognition of his numerous and valuable contributions in ichthyology.

#### Genus COTYLIS Müller and Troschel

*Cotylis* MÜLLER and TROSCHER, in Müller, Arch. für Naturg. (Wiegmann), 9th year, vol. 1, p. 297, 1843 (genotype: *Cotylis nuda* Müller and Troschel=*Lepadogaster nudus* Bloch and Schneider=*Gobiesox gyrinus* Jordan and Evermann=*Gobiesox nigripinnis* Peters) (*Cyclopterus nudus* Linnaeus not identified); Horae ichthyologicae, pt. 3, p. 17, pl. 3, fig. 2, 1849 (genotype: *Cotylis nuda* Bloch and Schneider). [*Cotylis* (non Müller and Troschel) Günther, Catalogue of the fishes in the British Museum, vol. 3, p. 498, 1861, but restricted to *Cotylis fimbriata* Müller and Troschel, 1849, from Red Sea, and not described in 1843. *Cotylis* Günther has the substitute name *Cotyllichthys* Jordan, Proc. Acad. Nat. Sci. Philadelphia, 1919, p. 341.]

*Bryssotaeres* JORDAN and EVERMANN, in Jordan, Proc. California Acad. Sci., vol. 6, p. 230, 1896 (genotype: *Gobiesox pinniger* Gilbert); U. S. Nat. Mus. Bull. 47, pt. 3, p. 2328, 1898 (genotype: *G. pinniger* Gilbert).

*Caulistius* JORDAN and EVERMANN, Rep. U. S. Comm. Fish and Fish. for 1895, App. p. 491, 1896. (Genotype: *Gobiesox papillifer* Gilbert.)

*Bryssophilus* JORDAN and EVERMANN, U. S. Nat. Mus. Bull. 47, pt. 3, pp. 2329, 2330, 1898. (Genotype: *Gobiesox papillifer* Gilbert.)

#### COTYLIS PAPILLIFER (Gilbert)

*Gobiesox papillifer* GILBERT, Proc. U. S. Nat. Mus., vol. 13, p. 96, 1890 (Magdalena Bay, Lower California).—JORDAN and EVERMANN, Rep. U. S. Comm. Fish and Fish. for 1895, App., p. 491, 1896 (Magdalena Bay); U. S. Nat. Mus. Bull. 47, pt. 3, p. 2330, 1898 (Magdalena Bay).

*Caulistius papillifer* JORDAN, EVERMANN, and CLARK, Rep. U. S. Comm. Fish. for 1928, pt. 2, p. 488, 1930 (Magdalena Bay).

*Material examined*.—BAJA CALIFORNIA (Magdalena Bay): U.S.N.M. No. 44376 (type of *papillifer*), collected by the *Albatross*.

*Range*.—Magdalena Bay, Baja California.



## COTYLIS MICROSPILUS (Fowler)

## PLATE 1, A

*Caulistius microspilus* FOWLER, Proc. Acad. Nat. Sci. Philadelphia, 1916, p. 412, fig. 4 (Panama Bay).

*Description.*—Head contained about  $2\frac{2}{3}$ , disk 2.9 or 3, greatest depth of body 5 to 6, in standard length; eye  $2\frac{1}{2}$  in interorbital space; disk a little shorter than length of head; tip of chin to front of disk about  $\frac{3}{4}$  to  $\frac{1}{2}$  length of disk; distance from base of last dorsal fin ray to midbase of caudal fin contained nearly three times in base of dorsal fin; dorsal origin nearly an eye diameter closer to midbase of caudal fin than to rear of orbit; depressed anal fin reaching a trifle past a line through caudal fin base, and depressed dorsal fin reaching to opposite caudal fin base; upper lip on premaxillary with a median papilla and five more on each side, but none posteriorly on upper lip; middle of snout with three short papillae or knobs, but edge of snout above groove without papillae anteriorly but about five well-developed ones laterally; another papilla behind rictus and one on lower lip below rictus; median part of chin and lower jaw with three rows of papillae, the most anterior being a pair of low lobes, next a pair of papillae, and the inner row consisting of two pairs of papillae, with the outer pair posterior to the anterior pair; lower lip at each side of median part of chin forming a small lobe bearing two small papillae; three large papillae along the inner edge of the groove along edge of lower lip on each side; preopercular spine well developed; three or four pairs of small incisorlike teeth at front of lower jaw in outer row; teeth at front of upper jaw nearly conical; lateral teeth of both jaws conical; a small patch of teeth behind outer teeth at front of both jaws; interorbital space flat; anterior nostril tubular with a short dermal flap, sometimes branched, arising at the posterior rim of this nostril; shoulder girdle with a fleshy lobe and a shallow groove along its lower edge separating it from the lower less fleshy lobe; base of pectoral fin with a fleshy lobe, the posterior and ventral margins free, this free margin beginning at point where gill membrane is fused opposite base of sixth or seventh pectoral ray from dorsal edge of that fin; upper edge of axial dermal flap behind pectoral fin is fused to base of fin opposite ninth or tenth ray from dorsal edge of pectoral fin; pelvic fin attached to near base of pectoral fin rays; lower rays of pectoral fin nearly as long as middle pectoral fin rays; margins of disk and pelvic pads of disk all covered with low flattened papillae; anus much closer to anal origin than to rear margin of disk.

*Coloration.*—In alcohol, pale brownish everywhere on dorsal surfaces of head and anterior parts of body profusely brown-spotted, these spots small and rather close together; tips of all rays of median



A



B

A, Lower side of head of *Cotylos microptilus* (Fowler), U.S.N.M. No. 107142. B, Lower side of head of *Cotylos nigripinnis nigripinnis* Peters, U.S.N.M. No. 58829. Drawn by Mrs. Aime M. Awl.



fins white; basally the dorsal, anal, and caudal fins are dark brown; more or less obscure pale bar across base of caudal fin.

*Material examined*.—The following three specimens, all collected by Dr. W. L. Schmitt, form the basis of the foregoing redescription of this species:

U.S.N.M. No. 88822, 26.5 mm., Salinas, Ecuador, September 15, 1926.

U.S.N.M. No. 88823, 58 mm., Guayaquil, Ecuador, 1926.

U.S.N.M. No. 107142, 62.6 mm., Paíta, Peru, October 7, 1926.

The three young specimens listed below, also collected by Dr. Schmitt, are referred to this species with uncertainty. They appear to be more robust than the adults.

U.S.N.M. No. 101713, 2 specimens, 14.5 and 15 mm., Cupica Bay, Colombia, January 26, 1935.

U.S.N.M. No. 101938, 1 specimen, 9.5 mm., Cupica Bay, Colombia, January 26, 1935.

*Range*.—Panama Bay to northern Peru.

#### COTYLIS NIGRIPINNIS NIGRIPINNIS Peters

##### PLATE 1, B

*Cotylis nigrispinnis* PETERS, Monatsb. Akad. Wiss. Berlin, 1859, p. 412, May 8, 1860 (Puerto Cabello [probably Venezuela]).

*Gobiesox nigrispinnis* GÜNTHER, Catalogue of the fishes in the British Museum, vol. 3, p. 502, 1861 (Puerto Cabello); Trans. Zool. Soc. London, vol. 6, p. 390, 1869 (Puerto Cabello).—JORDAN and EVERMANN, Rep. U. S. Comm. Fish and Fish. for 1895, App., p. 491, 1896 (Puerto Cabello); U. S. Nat. Mus. Bull. 47, pt. 3, p. 2331, 1898 (Puerto Cabello).—METZELAAR, Bijd. Dierk. Feest. Num. 70th Geboortedag van Dr. Max Weber, pt. 22, p. 140, 1922 (Caracas Bay).—JORDAN, EVERMANN, and CLARK, Rep. U. S. Comm. Fish. for 1923, pt. 2, p. 488, 1930 (Puerto Cabello).

*Gobiesox strumosus* COPE, Proc. Acad. Nat. Sci. Philadelphia, vol. 22, p. 121, 1870 (Hilton Head, S. C.).—JORDAN and EVERMANN, Rep. U. S. Comm. Fish and Fish. for 1895, App., p. 491, 1896 (Carolina to Florida); U. S. Nat. Mus. Bull. 47, pt. 3, p. 2333, 1898 (Hilton Head, S. C.; Indian River, Fla.; Titusville).—HILDEBRAND and SCHROEDER, Bull. U. S. Bur. Fish., vol. 43, pt. 1, p. 339, 1928 (Chesapeake Bay).—JORDAN, EVERMANN, and CLARK, Rep. U. S. Comm. Fish. for 1923, pt. 2, p. 489, 1930 (Maryland to Florida).—LONGLEY and HILDEBRAND, Systematic catalogue of the fishes of Tortugas, Florida, p. 284, 1941 (Tortugas, Fla.).

*Lepadogaster nudus* (non Linnaeus) BLOCH and SCHNEIDER, Systema ichthyologiae, p. 2, 1801 (locality?).

*Cotylis nuda* (non Linnaeus) MÜLLER and TROSCHEL, Horae ichthyologicae, pt. 3, p. 17, pl. 3, fig. 2, 1849 [West Indies].

*Gobiesox nudus* BRISOUT DE BARNEVILLE, Rev. Zool. Soc. Cuv., vol. 9, p. 144, 1846 (no locality).—GÜNTHER, Catalogue of the fishes in the British Museum, vol. 3, p. 502, 1861 (West Indies; Island of Cordova); Trans. Zool. Soc. London, vol. 6, p. 390, 1869 (Cardon).

*Gobiesox gyrinus* JORDAN and EVERMANN, Rep. U. S. Comm. Fish and Fish. for 1895, p. 491, 1896 (*nomen nudum*); U. S. Nat. Mus. Bull. 47, pt. 3, p. 2331, 1898 (West Indies) (based on *Gobiesox nudus* [non Linnaeus] Günther).—

- JORDAN, EVERMANN, and CLARK, Rep. U. S. Comm. Fish. for 1928, pt. 2, p. 489, 1930 (West Indies).
- Gobiesox virgatulus* GOODE and BEAN, Proc. U. S. Nat. Mus., vol. 5, p. 236, 1882 (Gulf of Mexico) (*nomen nudum*).—JORDAN and GILBERT, Proc. U. S. Nat. Mus., vol. 5, p. 293, 1882 (Pensacola, Fla.).—JORDAN, Proc. U. S. Nat. Mus. vol. 7, p. 149, 1884 (Egmont).—JORDAN and EVERMANN, Rep. U. S. Comm. Fish and Fish. for 1895, App., p. 491, 1896 (Pensacola Bay to Charleston, S. C.); U. S. Nat. Mus. Bull. 47, pt. 3 p. 2333, 1898 (Pensacola Bay north to Charleston).—SMITH, Fishes of North Carolina, p. 374, 1907 (Beaufort Harbor; Fort Macon; Charleston).—JORDAN, EVERMANN, and CLARK, Rep. U. S. Comm. Fish. for 1928, pt. 2, p. 489, 1930 (Pensacola Bay to Charleston).
- Gobiesox sancti-martini* METZELAAR, Report on the fishes collected by Dr. J. Boeke in the Dutch West Indies, 1904-1905, pt. 1, p. 151, fig. 48, 1919 (St. Martin, Simonsbay Lagoon).—JORDAN, EVERMANN, and CLARK, Rep. U. S. Comm. Fish. for 1928, pt. 2, p. 490, 1930 (West Indies).
- Gobiesox barbatulus* STARKS, The fishes of the Stanford Expedition to Brazil, p. 73, pl. 14, 1913 (Natal).—RIBEIRO, Fauna Brasiliense . . . Peixes . . . Gobiesocidae, p. 2, 1915 (Lagôa em Natal).
- "*Gobiesox yuma* Nichols=[non] *Gobiesox vittatus* Metzelaar=[non] *Gobiesox punctulatus* Poey," LONGLEY, Carnegie Inst. Washington Year Book No. 34, p. 284, 1935.
- "*Gobiesox virgatulus* Jordan and Gilbert=*G. strumosus* Cope," LONGLEY, Carnegie Inst. Washington Year Book, No. 33, p. 270, 1934.
- "*Gobiesox barbatulus* Starks=*Gobiesox gyrinus* Jordan and Evermann=*Gobiesox nigripinnis* Peters," LONGLEY, Carnegie Inst. Washington Year Book, No. 34, p. 284, 1935.
- Gobiesox yuma* NICHOLS, Bull. Amer. Mus. Nat. Hist., vol. 37, No. 37, p. 876, fig. 1, 1917 (Sanibel Light, Fla., west coast).—? BREDEB, Bull. Bingham Oceanogr. Coll., vol. 1, art. 1, p. 85, 1927 (Royal Islands, Bahamas).—JORDAN, EVERMANN, and CLARK, Rep. U. S. Comm. Fish. for 1928, pt. 2, p. 490, 1930 (Florida).

*Remarks.*—Müller and Troschel's description of *Cotylis nuda* (1849, pp. 17-18) leaves little doubt that their species is the same as the one recognized here as *nigripinnis*, since small barbels are said to occur around the mouth and the coloration is brownish with streaks of dark spots. In addition, fin rays are given as dorsal 12, anal 7.

When the form along the Atlantic coast from Chesapeake Bay to the east coast of Florida is studied in the minutest detail, it may be recognized as distinct from *nigripinnis*, but I have not thoroughly investigated the variation in the various localities from Maryland to Brazil. There are several names available for the races or subspecies that may be recognized.

Dr. S. F. Hildebrand kindly turned over to me the notes made by Dr. W. H. Longley at Amsterdam on the type of *Gobiesox sancti-martini* Metzelaar. I quote:

T. L. [total length] 69 mm. D. 12, A. 8, P. 23-24 including a stub above. Diameter of eye (orbit) 3.0 mm. Interorbital width 7.0 mm. Nasal cirri expanded, bilobed, without fringe. Twenty-nine coarse cirri, becoming bulbous under pressure of the tissue behind them, along front of ventral disk in single

series. The fleshy border lateral to them only slightly crenulated before the anterior ray of the ventral fin. The lower angle of the pectoral moderately prominent, not exerted. Opercular cleft extending upward to the base of 6th ray, the fold before the base of the fin complete, continuous with the fleshy border of the operculum. Anterior teeth little if any flattened, the lateral in the upper jaw running in behind the front but not as regularly as in some. . .

TABLE 3.—Counts and measurements made on species of *Cotyliis*, expressed in hundredths of the standard length

Characters	<i>microspilus</i>			<i>nigripinnis nigripinnis</i>		<i>nigripinnis woodsi</i>
	U.S.N.M. No. 88822	U.S.N.M. No. 88823	U.S.N.M. No. 107142	U.S.N.M. No. 87752	U.S.N.M. No. 87752	F.M.N.H. No. 41974
Standard length (in millimeters) .....	26.5	58	62.6	69	40	33
Length of head .....	41.5	41.2	41.0	40.6	42.0	41.2
Greatest depth of body .....	15.8	18.3	18.2	18.8	22.2	13.7
Greatest width of head .....	32.0	31.1	35.1	39.1	35.0	36.4
Length of caudal peduncle .....	8.30	9.32	8.79	10.1	11.5	7.58
Least depth of caudal peduncle .....	9.44	8.62	8.03	9.42	10.5	6.97
Length of snout .....	11.7	12.2	13.3	15.5	12.8	11.2
Diameter of eye .....	7.55	5.86	5.59	5.50	5.25	7.58
Width of interorbital space .....	10.9	14.7	13.6	13.0	12.7	9.40
Postorbital length of head .....	26.4	24.2	25.7	24.3	25.8	22.8
Length of disk .....	35.2	34.5	34.3	36.5	38.7	32.4
Distance from base last dorsal ray to midcaudal fin base .....	9.44	11.2	9.60	12.3	12.5	9.70
Gape or tip of snout to rictus .....	13.6	13.6	16.0	15.2	12.3	-----
Distance from rear margin of disk to anus .....	10.9	11.7	13.6	11.7	10.5	11.2
Anus (center) to anal origin .....	6.04	4.14	4.80	7.10	9.25	10.9
Snout tip to dorsal origin .....	61.1	59.2	60.0	64.5	65.0	69.1
Snout to anal origin .....	73.2	70.7	70.2	69.6	74.0	77.3
Snout to anus .....	64.9	66.9	65.5	62.3	65.0	63.7
Length of dorsal fin base (to base of last ray) .....	32.5	32.4	33.5	25.5	29.0	25.8
Length of anal fin base .....	21.1	22.1	21.6	21.7	20.0	16.7
Longest ray of dorsal fin .....	17.0	15.0	16.0	14.8	14.3	14.2
Longest ray of anal fin .....	15.1	12.4	12.8	12.0	13.0	11.5
Longest ray of caudal fin .....	30.6	26.7	26.4	24.3	26.3	26.4
Longest ray of pectoral fin .....	15.8	15.5	16.5	16.2	18.3	12.4
Length of third ray from bottom of pectoral fin .....	14.0	12.9	12.1	13.0	15.5	11.5
Number of pectoral fin rays .....	24-26	27-27	25-26	25-26	25-25	22-22
Dorsal rays .....	14	14	14	11	11	10
Anal rays .....	10	10	10	9	9	8
Number of upper pectoral rays above upper edge of attachment of gill membranes .....	6-7	7-7	6-6	6-6	6-7	6-6

See table 3 for measurements made on two specimens from Brazil.

I have examined the type of *Gobiesox yuma* Nichols and find that it possesses the barbellike structures around the mouth and in other respects resembles *Cotyliis nigripinnis nigripinnis* to which I refer it

as a synonym. The teeth of the lower jaw at the front have uneven edges but are not bifid or trifold as in certain other genera. I count dorsal rays as 12, anal as 9, and pectoral 23.

The following two collections, referred to this species with uncertainty, contain very small specimens that do not show certain characters fully developed and may represent an undescribed species of small size:

U.S.N.M. No. 83862, 4 specimens, 10.5 to 11 mm., Trinidad, *Albatross*, January 30–February 21, 1884.

U.M.M.Z. No. 131173, 4 specimens, 8.3 to 9.5 mm., Velasco, Tex., Rice Institute, April 17, 1923.

*Material examined*.—MARYLAND and VIRGINIA: U.S.N.M. Nos. 30400, 30407, 43064, 58829, 67760, 67761, 68391, 74852, 76530, 76531, 77929, 83593, 85087, 85681, 86313, 88583, 88586, 89340, 91210–91239, 92024, 92031, 93759, 93805, 104930, 109846, 122392, 122394, totaling 420 specimens. NORTH CAROLINA: U.S.N.M. Nos. 4905, 85088, 122395, 122396, total 4 specimens. SOUTH CAROLINA: U.S.N.M. Nos. 26311, 59053, 59061, totaling 9 specimens. FLORIDA: U.S.N.M. Nos. 26611, 30471, 30861 (2 cotypes of *virgatulus*), 32760, 34719, 34725, 73250, 85089, 85090, 91456, 92213, 92215, 93716, 93882, 94896, 116933–116935, 125493, totaling 31 specimens. ALABAMA: U.S.N.M. No. 73545, 2 specimens. MISSISSIPPI: U. S. N. M. No. 32625, 1 specimen. LOUISIANA: U.S.N.M. Nos. 86134, 122393, 124979, totaling 3 specimens; U.M.M.Z. No. 128860, 3 specimens. TEXAS: U.S.N.M. Nos. 69347, 69348, 118542, totaling 4 specimens; U.M.M.Z. Nos. 111746 and 114471, totaling 15 specimens. BRAZIL: U.S.N.M. Nos. 87752 and 87798, totaling 3 specimens.

*Range*.—Chesapeake Bay to Brazil; West Indies.

COTYLIS NIGRIPINNIS WOODSI, new subspecies

*Holotype*.—F.M.N.H. No. 41974, a specimen 33 mm. in standard length, from Cocos Island at Wafer Bay, collected February 23, 1941.

*Description* of only known specimen.—Detailed measurements were made and these are recorded in hundredths of the standard length in table 3.

Head contained about  $2\frac{1}{2}$ , disk 3, greatest depth of body about 7, in standard length; eye equal to bony interorbital space and  $1\frac{2}{3}$  in fleshy interorbital space; disk about 1.3 in head; tip of chin to front of disk about  $\frac{3}{5}$  length of disk; distance from base of last dorsal ray to midbase of caudal fin 2.7 in length of base of dorsal fin; dorsal origin equidistant between midbase of caudal fin and base of upper pectoral ray; tips of rays of depressed anal fin reaching a little past a line through base of caudal fin and depressed dorsal fin not reaching quite to that line; size and arrangement of papillae around mouth essentially as described for *nigripinnis*; about three pairs of incisorlike teeth at

front of lower jaw projecting obliquely forward, followed laterally by one or two somewhat enlarged conical teeth, then posteriorly by a short row of small conical teeth; inside of larger outer row of teeth a few smaller ones at front of lower jaw; upper jaw with conical teeth, those at front a little enlarged; none of the teeth with trifid tips; front of upper jaw inside of outer teeth with a few minute teeth; interorbital space flat; each anterior nostril with a bifid dermal flap on posterior margin; shoulder girdle with a fleshy lobe on its lower margin under gill cover; base of pectoral fin with a fleshy lobe, the posterior and ventral margins with a free edge that extends to the attachment of the opercular membrane, both of which are fused opposite the base of the sixth pectoral fin ray; upper edge of axial dermal flap behind pectoral fin fused to base of fin opposite the sixth pectoral ray; pelvic fins attached near base of about fourth pectoral fin ray; lower rays of pectoral fin nearly as long as middle rays; margins of disk and pelvic pads with low flattened papillae; anus a trifle closer to anal origin than to rear margin of disk.

*Coloration*.—General coloration pale brownish in alcohol, with five wide indistinct bars on body, the paler interspaces narrower than eye; sides of body with several very narrow pale lines; a dark elongate spot behind eye and a few narrow pale lines radiating posteriorly from orbit across gill cover; median fins black with tips of rays white.

*Remarks*.—This new subspecies is the representative of a similar form in the Atlantic from Maryland to Brazil herein recognized under the name *nigripinnis*. From that form *woodsii* may be distinguished by a larger eye and a less deep body, as indicated in the key.

Named *woodsii* in honor of Lt. Loren P. Woods, U. S. N. R., who tentatively suggested this specimen to be an undescribed species when he learned that I was studying the American clingfishes. Described with the permission of the authorities of the Chicago Natural History Museum.

#### COTYLIS PINNIGER (Gilbert)

*Gobiesox pinniger* GILBERT, Proc. U. S. Nat. Mus., vol. 13, p. 94, 1890 (Puerto Refugio, Ángel Island, San Luis Gonzales Bay, and La Paz, Gulf of California).—PELLEGRIN, Bull. Mus. Hist. Nat. Paris, vol. 7, p. 162, 1901 (Gulf of California).

*Bryssetaeres pinniger* JORDAN and EVERMANN, Proc. California Acad. Sci., vol. 6, p. 280, pl. 34, 1896; Rep. U. S. Comm. Fish and Fish. for 1895, App., p. 491, 1896 (Gulf of California); U. S. Nat. Mus. Bull. 47, p. 2328, 1898 (Gulf of California).—JORDAN, EVERMANN, and CLARK, Rep. U. S. Comm. Fish. for 1928, pt. 2, p. 488, 1930 (Gulf of California).—BREDER, Bull. Bingham Oceanogr. Coll., vol. 2, art. 3, p. 48, 1936 (Puerto Refugio; Gonzago Bay).

*Remarks*.—The longer base of the dorsal fin is not considered of generic significance in view of other related species with dorsal fins of nearly the same length.



*Material examined*.—GULF OF CALIFORNIA: U.S.N.M. Nos. 44377 (type of *pinniger*), 46694 (4 cotypes of *pinniger*), 126808 (25 cotypes of *pinniger*), totaling 30 specimens; F.M.N.H. No. 3338, 19 specimens.

*Range*.—Gulf of California.

### Genus SICYOGASTER Brisout de Barneville

*Sicyogaster* BRISOUT DE BARNEVILLE, Rev. Zool. Soc. Cuv., vol. 9, p. 144, 1846.  
(Genotype: *Gobiesox marmoratus* Jenyns.)

*Caularchus* GILL, Proc. Acad. Nat. Sci. Philadelphia, vol. 14, p. 330, 1862.  
(Genotype: *Caularchus reticulatus*=*Lepadogaster reticulatus* Girard.)

### SICYOGASTER MARMORATUS (Jenyns)

*Gobiesox marmoratus* JENYNS, The zoology of the voyage of H. M. S. *Beagle*, pt. 4, Fishes, p. 140, pl. 27, figs. 1, 1a, 1b, 1842.—GÜNTHER, Catalogue of the fishes in the British Museum, vol. 3, p. 504, 1861 (Chile).—?ABBOTT, Proc. Acad. Nat. Sci. Philadelphia, 1899, p. 363 (Peru).—DELFIN, Rev. Chilena Hist. Nat., vol. 3-4, p. 91, 1901 (Algarrobo; Chañaral; Punta Arenas; Calbuco; Iquique; Isla de Juan Fernández).—TORTONESE, Bol. Mus. Zool. Anat. Comp. Univ. Torino, vol. 47, p. 206, 1939 (Valparaíso).

*Sicyogaster marmoratus* BRISOUT DE BARNEVILLE, Rev. Zool. Soc. Cuv., vol. 9, p. 144, 1846 (Chile).

*Cotylis marmoratus* MÜLLER and TROSCHEL, Horae ichthyologicae, pt. 3, p. 19, 1849 (Chile).

*Remarks*.—The following notes on the type of *Gobiesox marmoratus* in the British Museum from "Archipelago of Chiloe," made by Dr. W. H. Longley, were kindly turned over to me by Dr. S. F. Hildebrand:

Two specimens of T. L. [total length] 56 and 64 mm. considerably macerated, the smaller better preserved. D. 12; A. 10; the last anal ray missing, but its support still evident. The pectoral both sides with 23 rays including the rudimentary one above. In the larger fish D. 12, A. 11.

In the small fish again I found that the membranous structure at pectoral base is evident for only half the vertical height of the fin but that in the lower half, where it is present, it exists as a very evident, freely projecting lobe.

On very careful examination, I find that the opercular cleft extends dorsally about to the base of the upper pectoral ray.

*Material examined*.—PERU: U.S.N.M. No. 101706, 1 specimen. CHILES U.S.N.M. Nos. 77381, 88819-88821, 88824, totaling 6 specimens.

*Range*.—Peru and Chile.

### SICYOGASTER MAEANDRICUS (Girard)

*Lepadogaster reticulatus* GIRARD, Proc. Acad. Nat. Sci. Philadelphia, 1854, p. 155 (San Luis Obispo, Calif.) (preoccupied).

*Lepadogaster maeandricus* GIRARD, Explorations and surveys for a railroad route from the Mississippi River to the Pacific Ocean, vol. 10, pt. 4, p. 130, 1858 (San Luis Obispo, S. Faralones, Calif.) (new name).

*Gobiesox maeandricus* GÜNTHER, Catalogue of the fishes in the British Museum, vol. 3, p. 505, 1861 (Monterey).

*Caularchus reticulatus* GILL, Proc. Acad. Nat. Sci. Philadelphia, vol. 14, p. 330, 1862.

*Gobiesox reticulatus* JORDAN and JOUY, Proc. U. S. Nat. Mus., vol. 4, p. 5, 1881 (Monterey and Cape Flattery).—JORDAN and GILBERT, Proc. U. S. Nat. Mus., vol. 4, p. 63, 1881 (Monterey to Puget Sound).—ROSA SMITH, Proc. U. S. Nat. Mus., vol. 4, p. 140, 141, 1881 (San Diego).

*Caularchus maeandricus* JORDAN and EVERMANN, Rep. U. S. Comm. Fish and Fish. for 1895, App., p. 491, 1896 (Vancouver Island to Monterey); U. S. Nat. Mus. Bull. 47, pt. 3, p. 2328, 1898 (Vancouver Island to Point Conception).—GUITEL, Arch. Zool. Expér., vol. 5, No. 5, pp. 625-639, 1906 (anatomy).—EVERMANN and GOLDSBOROUGH, Bull. U. S. Bur. Fish., vol. 26 p. 336, 1907 (Fort Rupert; Gabriola Island).—JORDAN, EVERMANN, and CLARK, Rep. U. S. Comm. Fish. for 1928, pt. 2, p. 488, 1930 (Vancouver Island to Monterey).—SCHULTZ, Keys to the fishes of Washington, Oregon and closely adjoining regions, ed. 1, p. 197, 1936 (British Columbia to Point Arguello, Calif.).—SCHULTZ and DeLACEY, Journ. Pan-Pacific Res. Inst. (Mid-Pacific Mag.), July-September, 1936, p. 211, 213 (British Columbia to Point Arguello, Calif.) (see this reference for additional references).—WILBY, Copeia, 1936, p. 116 (British Columbia).

*Material examined*.—BRITISH COLUMBIA: U.S.N.M. Nos. 49083, 60548, 60549, 64022, 82153, 82154, 103563, 103564, 103566, 103567, 120446, 120447, 126811, totaling 64 specimens. WASHINGTON: U.S.N.M. Nos. 23405, 27329, 38334, 42049, 83208, 83964, 103565, totaling 32 specimens. OREGON: U.S.N.M. No. 91974, 1 specimen. CALIFORNIA: U.S.N.M. Nos. 516 (type of *reticulatus*=*maeandricus*), 101382, 101383, 101388, totaling 4 specimens.

*Range*.—Queen Charlotte Islands to San Diego, Calif.; Puget Sound.

#### ARCOS, new genus

*Genotype*.—*Gobiesox erythrops* Gilbert.

This genus is characterized by the groove along the anterior or upper margin of the premaxillary which arches in a convex manner over the tip of the snout; the orbits are larger than in any other genus of American clingfishes, their diameter much greater than the least width of the bony interorbital. In addition, the axial dermal flap behind the pectoral fin has its dorsal edge attached much above the midbase of pectoral; the incisorlike teeth at front of lower jaw have smooth tips, and these teeth project forward horizontally and do not oppose the teeth at front of upper jaw, which are nearly conical; there are no papillae around the mouth, although the usual lobelike ridges occur on lower jaw and chin; gill membranes are joined at upper edge of pectoral fin base or appear to be opposite base of first pectoral fin ray; the free posterior margin of fleshy pad on outer surface of pectoral base is confined to the lower half of that fin and not above the thirteenth ray from the top. Other characters are those of the genotype.

Names *Arcos* in reference to the arched groove on the tip of the snout.

## ARCOS POECILOPHTHALMUS (Jenyns)

*Gobiesox poecilophthalmus* JENYNS, The zoology of the voyage of H. M. S. *Beagle*, pt. 4, Fishes, p. 141, pl. 27, fig. 2, 2a 2b, 1842 (Chatham Island).—GÜNTHER, Catalogue of the fishes in the British Museum, vol. 3, p. 503, 1861 (Chatham Island).—JORDAN and EVERMANN, Rep. U. S. Comm. Fish and Fish. for 1895, App., p. 491, 1896 (Chatham Island); U. S. Nat. Mus. Bull. 47, pt. 3, p. 2335, 1898 (Chatham Island).

*Cotylis poecilophthalmus* MÜLLER and TROSCHEL, Horae ichthyologicae, pt. 3, p. 19, 1849 (Galápagos).

*Tomiscodon poecilophthalmos* BRISOUT DE BARNEVILLE, Rev. Zool. Soc. Cuv., vol. 9, p. 144, 1846.

*Gobiesox erythrops* JORDAN and GILBERT, Proc. U. S. Nat. Mus., vol. 4, p. 360, 1882 (Mazatlán).—JORDAN and EVERMANN, Rep. U. S. Comm. Fish and Fish. for 1895, App., p. 491, 1896 (Mazatlán; Tres Marias Island); U. S. Nat. Mus. Bull. 47, pt. 3, p. 2336, 1898 (Mazatlán).—JORDAN, EVERMANN, and CLARK, Rep. U. S. Comm. Fish. for 1928, pt. 2, p. 490, 1930 (Mazatlán; Tres Marias Island).

*Gobiesox paradiseus* HERRE, Publ. Field Mus. Nat. Hist., zool. ser., vol. 18, p. 432, 1935 (Eden Island; South Seymour Island); vol. 21, p. 393, fig. 36, 1936 (Eden Island; South Seymour Island).

*Remarks.*—This species is recognizable by its very large eyes and narrow interorbital space. It is a small species and usually red in color.

Dr. S. F. Hildebrand kindly turned over the following note by Dr. W. H. Longley on the type of *Gobiesox poecilophthalmus* from Chatham Island:

T. L. [total length] 45 mm. D. 8, A. 7, P. 21+rod [or 22 rays].

*Material examined.*—MAZATLÁN: U.S.N.M. No. 30885 (type of *erythrops*). PANAMA BAY (Secas Islands): U.S.N.M. No. 101708, 5 specimens. GALÁPAGOS ISLANDS: U.S.N.M. No. 65516, 1 specimen; F.M.N.H. Nos. 17404 and 17405 (type and paratype of *paradiseus*).

*Range.*—Mazatlán to Panama and Galápagos Islands.

## ARCOS MACROPHTHALMUS (Günther)

*Gobiesox macrophthalmus* GÜNTHER, Catalogue of the fishes in the British Museum, vol. 3, p. 502, 1861 (habitat unknown) [probably West Indies].—JORDAN and EVERMANN, U. S. Nat. Mus. Bull. 47, pt. 3, p. 2335, 1898 (St. Thomas).—METZELAAR, Bijd. Dierk. Feest. Num. 70th Geboortedag van Dr. Max Weber, pt. 22, p. 140, 1922 (Caracas Bay).—BEEBE and TEE-VAN, Zoologica, vol. 10, No. 1, p. 251, fig., 1928 (Lamentin Reef, Port-au-Prince Bay, Haiti).—JORDAN, EVERMANN, and CLARK, Rep. U. S. Comm. Fish. for 1928, pt. 2, p. 489, 1930 (probably West Indies).

*Gobiesox cerasinus* COPE, Trans. Amer. Philos. Soc., vol. 14, p. 413, 1871 (St. Martins, West Indies).—JORDAN and EVERMANN, Rep. U. S. Comm. Fish and Fish. for 1895, App., p. 492, 1896 (St. Martins); U. S. Nat. Mus. Bull. 47, pt. 3, p. 2336, 1898 (St. Martins).—FOWLER, Proc. Acad. Nat. Sci. Philadelphia, vol. 71, p. 143, 149, 1919 (St. Martins; Jamaica).—? METZELAAR, Bijd. Dierk. Feest. Num. 70th Geboortedag van Dr. Max Weber, pt. 22, p. 140, 1922 (Caracas Bay).—JORDAN, EVERMANN, and CLARK, Rep. U. S. Comm. Fish. for 1928, pt. 2, p. 489, 1930 (St. Martins, West Indies).

- Gobiesox tudes* EVERMANN and MARSH, Bull. U. S. Fish Comm., vol. 20, pt. 1, p. 305, 1900 (Culebra, Puerto Rico).  
*Sicyases yumurina* RIVERO, Proc. Boston Soc. Nat. Hist., vol. 41, No. 4, p. 74, 1936 (Matanzas, reef at entrance of the Bay).  
*Gobiesox androsiensis* ROSEN, Lunds Univ. Års-Skr., new ser. (Afd. Math. Nat.), vol. 7, No. 5, p. 65, 1911 (Mastic Point, Andros; Nassau, Bahamas).—JORDAN, EVERMANN, and CLARK, Rep. U. S. Comm. Fish. for 1928, pt. 2, p. 489, 1930 (Bahamas).  
*Gobiesox androsiensis* ROSEN=[not] *Gobiesox rubiginosus* (Poey), LONGLEY, Carnegie Inst. Washington, Year Book, No. 34, p. 284, 1935.  
*Gobiesox cephalus* METZELAAR, Bijd. Dierk. Feest. Num. 70th Geboortedag van Dr. Max Weber, pt. 22, p. 139, 1922 (Caracas Bay) (see comment below).  
*Gobiesox macrophthalmus* JORDAN and EVERMANN, Rep. U. S. Comm. Fish and Fish. for 1895, App., p. 492, 1896 (West Indies).

*Remarks.*—This species has the largest eyes of any American form in the Atlantic and is red in color when alive. The eyes are much wider than the narrow interorbital space.

Through the kindness of Dr. Thomas Barbour I have examined a paratype of *Sicyases yumurina* Rivero and refer it to this species. Some traces of the red color still remain on this specimen.

Dr. S. F. Hildebrand very kindly turned over to me the following notes by Dr. W. H. Longley made on the type of *Gobiesox macrophthalmus* Günther in the British Museum:

T. L. [total length] 54 mm. D. 8; A. 7. First ray in each fin very slightly filamentous. P. 22 and a short, vestigial upper 23rd. Same on both sides. The outline of the fin rounded. A strong subopercular spine with a deep groove on its ventral surface and reaching beyond the base of any of the pectoral rays. The membranous sac at the base of the pectoral extends upward only to the base of the eighth ray counting up from the ventral margin, but is a very evident structure. The opercular cleft is of the full width of the pectoral base and extends up to the level of the upper margin of the dwarf ray, which is quite a sizable stub one-third the length of the second.

Eye 5.0 mm.=snout; bony interorbital=3.0 mm.=preorbital width . . .

The dorsal origin midway between tip of caudal and posterior margin of the pupil.

Dr. Hildebrand also turned over to me the following notes made by Dr. Longley in the Berlin Museum, on the probable types of *Gobiesox androsiensis* collected by Rosen in the Bahamas:

Spec. 1. T. L. [total length] 26 mm. D. 7, A. 6, P. 24-24, the outer ray short. Two or three pairs of teeth above slightly flattened. Three pairs below more flattened, the anterior distinctly enlarged. The border of the lower incisors only slightly crenulated, more nearly truncate than on No. 3. The branchial cleft extending up to the base of the upper pectoral ray. No groove on the subopercular spine. The nasal cirrus is a flap half the diameter of the narial orifice in width. On one side it ends in two filaments . . .

Spec. 2. T. L. 25 mm. D. 8, A. 7. Gill apparatus as above . . .

Spec. 3. T. L. 22 mm. D. 9, A. 7, P. 22-22. Gill apparatus as above . . . Anterior face of lower incisors slightly fluted, the free border of the teeth almost bicuspid.

Dr. Hildebrand furnished me the following notes made by Dr. Longley in the Museum at Amsterdam on specimens reported upon by Metzelaar (1922) from Curaçao (Caracas Bay):

*Gobiesox macrophthalmus* . . . much fringed nasal cirri, the wide opercular cleft, the incomplete fold behind it with isolated lower lobe.

T. L. [total length] 70 mm. D. 8, A. 7, P. 24-24 including stub.

*Gobiesox cephalus* . . . Is the same as last [*macrophthalmus*] . . . T. L. 20 mm. D. 8, A. 7, P. 23-23, stub included . . . The gill cleft extends entire width of base of pectoral fin. I get no fold at all along the fin base. The anterior teeth of the lower jaw are enlarged, the middle much flattened and larger than the next pair.

*Material examined*.—BAHAMA ISLANDS: U.S.N.M. Nos. 38386 and 53220, totaling 2 specimens. JAMAICA: U.S.N.M. No. 78142, 1 specimen. ST. THOMAS: U.S.N.M. Nos. 78157 and 78158, totaling 2 specimens. SAN JUAN ISLAND: U.S.N.M. No. 117423, 4 specimens. VIRGIN ISLANDS: U.S.N.M. No. 117412, 3 specimens. MARTINIQUE: U.S.N.M. No. 117452, 2 specimens. PUERTO RICO: U.S.N.M. No. 126181, 1 specimen.

*Range*.—Bahama Islands and West Indies.

#### Genus GOBIESOX Lacepède

*Gobiesox* LACEPÈDE, Histoire naturelle des poissons, vol. 2, p. 595, fig., 1800. (Genotype: *Gobiesox cephalus* Lacepède.)

*Megaphalus* RAFINESQUE, Analyse de la nature, p. 86, 1815. (Genotype: *Gobiesox cephalus*.) (Substitute name for *Gobiesox*.)

#### GOBIESOX CEPHALUS Lacepède

*Gobiesox cephalus* LACEPÈDE, Histoire naturelle des poissons, vol. 2, pp. 595, 596, fig., 1800 (fresh-water rivers of South America).—BRISOUT DE BARNEVILLE, Rev. Zool. Soc. Cuv., vol. 9, p. 145, 1846 (Martinique).—GÜNTHER, Catalogue of the fishes in the British Museum, vol. 3, pp. 499, 566, 1861 (Caribbean Sea; St. Domingo; West Indies).—JORDAN and EVERMANN, Rep. U. S. Comm. Fish and Fish. for 1895, App., p. 491, 1896 (West Indies); U. S. Nat. Mus. Bull. 47, pt. 3, p. 2332, 1898 (Caribbean Sea).—GUITEL, Arch. Zool. Expér., vol. 5, No. 5, pp. 640-645, 1906 (anatomy).—BLOSSER, Ann. Carnegie Mus., vol. 6, p. 300, 1909 (St. Croix).—FOWLER, Proc. Acad. Nat. Sci. Philadelphia, vol. 71, p. 143, 1919 (St. Martins, West Indies).—JORDAN, EVERMANN, and CLARK, Rep. U. S. Comm. Fish. for 1928, pt. 2, p. 489, 1930 (West Indies).—? RIVERO, Proc. Boston Soc. Nat. Hist., vol. 41, No. 4, p. 73, 1936 (Habana).

*Gobiesox tudes* RICHARDSON, Zoology of the voyage of H. M. S. *Sulphur*, Ichthyology, vol. 1, p. 103, pl. 46, figs. 1-3, 1844 (locality unknown).—JORDAN and EVERMANN, U. S. Nat. Mus. Bull. 47, pt. 3, p. 2333, 1898 (West Indies).—JORDAN, EVERMANN, and CLARK, Rep. U. S. Comm. Fish. for 1928, pt. 2, p. 489, 1930 (probably West Indies).

*Gobiesox tudes* Richardson=*Gobiesox cephalus* Lacepède, LONGLEY, Carnegie Inst. Washington Year Book, No. 34, p. 284, 1935.

*Cotylls stannii* MÜLLER and TROSCHEL, Horae ichthyologicae, pt. 3, p. 18, pl. 3, fig. 3, 1849 (Brazil).

*Gobiesox costaricensis* MEEK, Publ. Field Mus. Nat. Hist., zool. ser., vol. 10, No. 7, p. 74, 1912 (Zent River, Atlantic drainage, Costa Rica).—BEHRE, Ann.

Carnegie Mus., vol. 18, p. 314, 1928 (tributary to Río Cricamola near Conquantu).—JORDAN, EVERMANN, and CLARK, Rep. U. S. Comm. Fish. for 1928, pt. 2, p. 489, 1930 (Costa Rica).

*Gobiesox ramsdeni* RIBEIRO, Proc. Boston Soc. Nat. Hist., vol. 41, No. 4, p. 73, 1936 (Río Toa, "El Palenque" Yateras, Guantánamo, in Oriente Province, Cuba).

*Remarks.*—Dr. S. F. Hildebrand kindly turned over to me the following note made by Dr. W. H. Longley in the Paris Museum of Natural History on a specimen, No. 5134, of *Gobiesox cephalus* Lacepède:

T. L. [total length] 95 mm., D. 8, A. 6, P. 21 and a stub on outer side. If any are Lacepède's specimens, this must be it, others are all too late.

Contrary to most references in the literature, Lacepède did not report *G. cephalus* from the "Caribbean Sea" but from fresh-water rivers of South America. Since Lacepède mentions fresh water once and rivers twice in his description as the habitat of this species, I assume he did not make a mistake in the locality where the species occurred.

I have before me a series of specimens of *Gobiesox* from fresh-water streams of northern South America and Central America on the Atlantic side, and these agree in most characteristics throughout the area represented. Noteworthy is the arrangement of the teeth. On the lower jaw anteriorly the teeth of the outer row are somewhat enlarged, short, narrow and incisorlike, not crowded or projecting forward at the symphysis; front of upper jaw with conical teeth; lateral teeth in both jaws conical; sometimes with one or two enlarged caninelike teeth at front sides of lower or upper jaws; upper jaw with an inner patch of small conical teeth; origin of dorsal fin usually equidistant between midbase of caudal fin and tips of pectoral fin rays; anus usually equidistant between anal origin and rear margin of disk or a little closer to anal origin; anal origin behind middle of bases of dorsal fin rays or under the fifth or sixth; anus slightly in front of a vertical line through dorsal origin; head 2.2 to 2.6; disk 2.6 to 3.2; depth 4 to 5.5, all in standard length; interorbital equals snout.

There is a black blotch near base of dorsal fin on first rays that appears to occur constantly on the specimens examined.

William C. Schroeder, Museum of Comparative Zoology, kindly checked the type of *Gobiesox ramsdeni* (M. C. Z. No. 34152) and made the following observations:

Posterolateral teeth of lower jaw more caninelike and not smaller than front teeth; no papilla on upper or lower jaws (unless I overlooked this); length of disk equals disk to midbase of anal; anus closer to anal origin than to rear margin of disk by an eye's diameter. Standard length 107 [mm.]; head 43; length of disk 36; depth of body 25; D. 8; A. 5 or 6; P. 20; eye 5; interorbital 16.

The foregoing counts may be considered as correcting those given in the original description of *ramsdeni*.

*Material examined.*—WEST INDIES: U.S.N.M. Nos. 26479, 29848, 93793, totaling 11 specimens. COSTA RICA: U.S.N.M. No. 74246 (paratype of *costaricensis*); F. M. N. H. Nos. 7677 and 7813 (type and 2 paratypes of *costaricensis*), 7814, 7815, totaling 6 specimens. VENEZUELA (Macuto): U.S.N.M. Nos. 93815–93817, 93820–93822, 93827, totaling 16 specimens. COLOMBIA (Río Dagua): U.S.N.M. No. 120217, 1 specimen.

*Range.*—West Indies; Costa Rica to Brazil.

#### GOBIESOX FULVUS Meek

*Gobiesox fulvus* MEEK, Publ. Field Columbian Mus., zool. ser., vol. 7, No. 5, p. 149, 1907 (Cocos Island).

*Remarks.*—The following specimens were studied: COCOS ISLAND: F. M. N. H. No. 6035 (type of *fulvus*); U.S.N.M. No. 91832, 1 specimen; U. M. M. Z. Nos. 131512 and 131513, 2 specimens.

*Range.*—Cocos Island.

#### GOBIESOX PUNCTULATUS (Poey)

*Sicyases punctulatus* POEY, Enumeratio piscium Cubensium, p. 124, 1876 (Cuba).—JORDAN, EVERMANN, and CLARK, Rep. U. S. Comm. Fish. for 1928, pt. 2, p. 490, 1930 (Cuba).

*Gobiesox punctulatus* JORDAN and EVERMANN, Rep. U. S. Comm. Fish. and Fish. for 1895, App., p. 492, 1896 (Cuba); U. S. Nat. Mus. Bull. 47, pt. 3, p. 2338, 1898 (Cuba).—METZELAAR, Bijd. Dierk. Feest-Num. 70th Geboortedag van Dr. Max Weber, pt. 22, p. 140, 1922 (Caracas Bay).

*Gobiesox haeres* JORDAN and BOLLMAN, Proc. U. S. Nat. Mus., vol. 11, p. 552, 1889 (Green Turtle Cay, Bahamas).—JORDAN and EVERMANN, Rep. U. S. Comm. Fish. and Fish. for 1895, App., p. 492, 1896 (Green Turtle Cay, Bahamas); U. S. Nat. Mus. Bull. 47, pt. 3, p. 2337, 1898 (Green Turtle Cay, Bahamas).

*Gobiesox nudus* METZELAAR, Report on the fishes collected by Dr. J. Boeke in the Dutch West Indies 1904–1905, pt. 1, p. 151, 1919 (Curaçao and Bonaire).

*Gobiesox l[haeres]* Jordan and Bollman=*G. punctulatus* (Poey), LONGLEY, Carnegie Inst. Washington, Year Book, No. 33, p. 271, 1934.

*Gobiesox vittatus* METZELAAR, Bijd. Dierk. Feest-Num. 70th Geboortedag van Dr. Max Weber, pt. 22, p. 140, fig. 3, 1922 (Caracas Bay).—JORDAN, EVERMANN, and CLARK, Rept. U. S. Comm. Fish. for 1928, pt. 2, p. 489, 1930 (Curaçao).

*Sicyases haeres* JORDAN, EVERMANN, and CLARK, Rep. U. S. Comm. Fish. for 1928, pt. 2, p. 490, 1930 (Green Turtle Cay, Bahamas).

*Remarks.*—This is a small species and may be recognized by its relatively short, thick and deep body giving it the appearance of robustness.

Dr. S. F. Hildebrand kindly turned over to me the notes made by Dr. W. H. Longley in the Museum at Amsterdam on the type of *Gobiesox vittatus* Metzelaar, which follow:

T. L. [total length] 29.0 mm., D. 11, A. 7. P. 19–20, orbit 2.0 mm. Interorbital 2.0 mm., anterior margin of sucking disk crenulated, the units not stalked. The nasal cirrus small, expanded, doubly pointed. Opercular cleft extending up to

base of 5th pectoral ray, the fold behind it complete, with a distinct lobe below. The origin of the dorsal midway between tip of snout and of tip of caudal. The anterior teeth above simple, sharp-pointed, circular in cross-section, I think. Three pairs anterior teeth below flattened, not truncate, but leaf-shaped or even a little more spatulate.

Body pretty uniformly covered with dark chromatophores at an average distance from one another of twice their diameter . . .

*Material examined*.—BAHAMA ISLANDS: U.S.N.M. No. 41733 (type of *haeres*). CUBA: U.S.N.M. No. 37531, 5 specimens. TEXAS: U.S.N.M. No. 121962, 1 specimen. BRITISH HONDURAS: U.S.N.M. No. 91816, 1 specimen. LOCALITY UNKNOWN: U.S.N.M. No. 34442, 1 specimen.

*Range*.—Bahama Islands and West Indies; Texas and British Honduras.

GOBIESOX ADUSTUS Jordan and Gilbert

*Gobiesox adustus* JORDAN and GILBERT, Proc. U. S. Nat. Mus., vol. 4, p. 360, 1882 (Mazatlán); vol. 5, p. 627, 1883 (Central America).—JORDAN and EVERMANN, Rep. U. S. Comm. Fish and Fish. for 1895, App., p. 491, 1896 (Mazatlán); U. S. Nat. Mus. Bull. 47, pt. 3, p. 2334, 1898 (Mazatlán; Pacific coast of Mexico).—JORDAN, EVERMANN, and CLARK, Rep. U. S. Comm. Fish. for 1928, pt. 2, p. 489, 1930 (Pacific coast of Mexico).

*Material examined*.—U.S.N.M. No. 29249 (3 types of *adustus*), Mazatlán, C. H. Gilbert.

*Range*.—Mazatlán, Mexico.

GOBIESOX FUNEBRIS Gilbert

*Gobiesox funebris* GILBERT, Proc. U. S. Nat. Mus., vol. 13, p. 95, 1890 (Puerto Refugio, Ángel Island, and La Paz, Gulf of California).—JORDAN and EVERMANN, Rep. U. S. Comm. Fish and Fish. for 1895, App., p. 491, 1896 (Gulf of California); U. S. Nat. Mus. Bull. 47, pt. 3, p. 2334, 1898 (Ángel Island and La Paz, Gulf of California).—JORDAN, EVERMANN, and CLARK, Rep. U. S. Comm. Fish. for 1928, pt. 2, p. 489, 1930 (Gulf of California).—BREDER, Bull. Bingham Oceanogr. Coll., vol. 2, art. 3, p. 48, 1936 (Puerto Refugio) .

*Remarks*.—This species may be recognized by its small disk, the attachment of the gill membranes opposite the bases of the fifth or sixth pectoral fin rays, and the poor development of the fleshy pad on outer pectoral fin base, along with its narrower head.

*Material examined*.—GULF OF CALIFORNIA: U.S.N.M. Nos. 44378 (type of *funebris*), 119720, 124955 (2 cotypes of *funebris*), totaling 4 specimens; F.M.N.H. No. 8997, 2 specimens.

*Range*.—Gulf of California.







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## NEW BEETLES OF THE FAMILY EUCNEMIDIDAE FROM CENTRAL AMERICA AND THE WEST INDIES

By W. S. FISHER

DURING the process of rearranging the American species of the family Eucnemididae (Coleoptera) in the United States National Museum, a number of new genera and species were found. These are described herein. According to Fleutiaux (Rev. Franç. Ent., vol. 2, p. 1, 1935), the name Eucnemididae should be used for this family instead of Melasidae.

### Genus TEMNILLUS Bonvouloir

#### TEMNILLUS ASPERICOLLIS, new species

Oval-oblong, dark reddish brown, the antenna slightly paler, opaque, glabrous.

Head irregularly convex, with an irregular, deep, transverse depression on vertex and a very deep, irregular depression between antennae, coarsely, deeply, densely punctate, the intervals vaguely granulose; clypeus short, wide, anterior margin strongly, obtusely toothed at middle, broadly, arcuately emarginate on each side. Antenna not extending to base of pronotum, compact; first segment large, irregular, slightly flattened, as long as following five segments united, with a sharp tooth on underside at apex; segments 2 to 10 wider than long, each with two round depressions on upper surface; segment 11 obliquely truncate at apex.

Pronotum distinctly wider than long, strongly convex, with a narrow, longitudinal, median groove extending from base to apex and a small, deeper depression at middle of groove; sides nearly parallel, slightly sinuate along basal two-thirds, broadly rounded anteriorly; base truncate, posterior angles strongly projecting backward; surface

coarsely, asperately punctate at middle, ocellate-punctate toward sides. Scutellum square, coarsely punctate at middle, broadly rounded at apex.

Elytra very strongly convex, strongly striate, the striae deeper near apex; sides parallel from bases to apical third, then arcuately narrowed to apices, which are conjointly obtusely angulated; surface densely, finely rugose and finely punctate, the striae coarsely, deeply punctate.

Abdomen beneath coarsely, densely, uniformly punctate, last sternite with two round, deep depressions; prosternal process narrow, coarsely punctate, rounded at apex, sides nearly parallel; posterior coxae triangular.

Length 9.5 mm., width 3.25 mm.

*Type locality*.—Verdant Vale, Arima, Trinidad, British West Indies.

*Type*.—U.S.N.M. No. 57163.

*Remarks*.—Described from a single specimen collected at the type locality.

This species resembles *Temnillus lepriouri* (Guérin) but differs from that species in being more elongate and in having the head very deeply depressed between the antennae and on the vertex, with the surface more finely punctured, the anterior margin of the clypeus strongly toothed at the middle, the pronotum longitudinally grooved with a distinct depression at the middle, and the disk asperately punctured, the elytra strongly striate with the intervals finely rugose and the scutellum and prosternal process coarsely punctured.

#### NEODIAPODIUS, new genus

Body elongate, subcylindrical, slightly attenuate posteriorly. Head large, moderately convex, boardly, transversely flattened behind clypeus; labrum invisible; eyes partially covered by prothorax; clypeus moderately contracted at base. Antenna short, extending slightly beyond base of pronotum, slightly serrate in male, strongly serrate in female; second segment very small; third segment slightly shorter than first; segments 4 to 10 slightly shorter than third and subequal in length to one another; segment 11 narrowly oblong, acute at apex. Palpi abnormal, last segment of labial and maxillary palpi in male broadly rounded at base, nearly four times as long as wide at base, one-third as wide at apex as at base, with the outer margin slightly concave and inner margin slightly convex, in the female short, broadly oblong, twice as long as wide at middle, with outer margin obliquely truncate on apical half and inner margin strongly convex, the outer surface with a round depression at middle. Pronotum as long as wide, rounded and slightly sinuate in front, but not carinate; lateral margins distinct, entire; posterior angles strongly projecting backward.

Scutellum elongate-triangular, gibbose anteriorly, slightly emarginate at apex. Elytra strongly convex, attenuate posteriorly, distinctly striate. Propleural triangle as long as wide at base; antennal groove along lateral margin shallow, not very wide, smooth along outer margin, not margined internally. Marginal carina and prosternal suture converging anteriorly, the latter closed, carinate and strongly elevated anteriorly. Metasternal epimeron visible. Metasternal episternum broad, sides parallel. Posterior coxae broad, sides parallel. Abdomen convex; last sternite slightly gibbose toward apex, which is produced into a short, broad, truncate projection. Femora compressed. Tibiae subcylindrical. Tarsi shorter than tibiae, without lamellae; first segment slightly shorter than following segments united; fourth segment hollowed out on dorsal surface for receiving following segment, truncate at apex; tarsal claws robust, cleft near apices.

*Genotype*.—*Neodiapodius buscki*, new species.

This genus is allied to *Diapodius* Bonvouloir, but it differs from the description given for that genus in having the pronotum not longer than wide, the propleural triangle as long as wide at the bottom, the metasternal epimeron visible, the clypeus sinuate in front, the metasternal episternum broad with the sides parallel, the posterior tarsi shorter than the tibiae, the first segment of the posterior tarsus slightly shorter than the following segments united, the tarsal claws cleft near the tips, and the male antenna only slightly serrate.

NEODIAPODIUS BUSCKI, new species

*Male*.—Elongate, strongly convex, uniformly reddish brown, with the legs and palpi slightly paler, subopaque, rather densely clothed with very short, recumbent, whitish hairs.

Head coarsely, confluent, rugosely punctate, without a longitudinal carina; interocular carinae slightly elevated, not extending beyond antennal sockets; clypeus at base twice as wide as distance between it and eye, in front broadly rounded at middle and sinuate on each side, surface longitudinally carinate at middle.

Pronotum strongly convex anteriorly, depressed along base, with a more or less distinct longitudinal, median depression extending from base to near apex; sides parallel along basal two-thirds, arcuately narrowed near apex; surface coarsely, confluent, rugosely punctate.

Elytra with sides parallel to middle, then gradually narrowed to the tips, which are slightly separated and acute; surface rather deeply, longitudinally striate; intervals slightly convex, densely, finely granulose basally, becoming finely, sparsely punctate toward apices.

Body beneath densely punctate on abdomen, more coarsely and deeply on prosternum, mesosternum, and metasternum; last abdominal sternite coarsely granulose toward apex.

Length 14 mm., width 4.5 mm.

*Female*.—Differs from the male in being larger, and in having the abdomen more densely clothed at the middle with more conspicuous, longer, erect hairs, and the last sternite more obliquely narrowed toward the apex, the tarsal claws cleft farther from the tips with the inner tooth of each claw much shorter than the outer one, and the palpi and antennae of different shapes.

Length 17–20 mm., width 5.5–6 mm.

*Type locality*.—La Chorrera, Panama.

*Type, allotype, and paratypes*.—U.S.N.M. No. 57164.

*Remarks*.—Described from five specimens (1 male type) collected at the type locality by August Busck, the male type on May 14, 1912, and four females on May 17, 1912.

### Genus DROMAEOLUS Kiesenwetter

#### DROMAEOLUS PULCHER, new species

Oblong, slightly convex above, moderately shining, dark brown, elytra and abdomen more reddish, legs yellowish brown, the elytra ornamented with whitish pubescent designs.

Head slightly convex, vaguely, transversely depressed in front of clypeus, with a vague, short, longitudinal, smooth, median carina, finely, confluent punctate, sparsely clothed with moderately long, semierect, whitish hairs; interocular carina very strongly elevated, not interrupted and broadly rounded at middle; clypeus very narrow at base, one-half as wide as distance to eye, broadly sinuate at apex, broadly depressed near anterior margin and with a strongly elevated, short, longitudinal carina at base. Antenna rather robust, densely pubescent, longitudinally carinate, not distinctly serrate; third segment vaguely longer than second; segments 3 to 10 as wide as long and subequal in length to one another; segment 11 oblong, acute at apex.

Pronotum slightly shorter at middle than wide at base, strongly convex, deflexed along base; sides arcuately converging from bases to apices; posterior angles strongly projecting backward along sides of elytra; surface densely, finely, uniformly punctate, densely clothed along sides and base with long, recumbent, whitish hairs, hairs on median part not conspicuous.

Elytra slightly convex; sides converging from bases to tips, which are conjointly broadly rounded; surface not striate, densely, finely punctate, densely clothed with long, semierect, blackish hairs, and each elytron ornamented with long, recumbent, whitish hairs as follows: A narrow fascia along base broadly expanded at humeral angle, a narrow band along sutural margin connected to a broad fascia at middle, and a broad fascia at apex.

Body beneath finely, densely punctate, rather densely clothed with moderately long, recumbent, whitish hairs; antennal grooves marginal, narrow, equal in width for their entire length; prosternal suture not deeply grooved; posterior coxae strongly expanded internally.

Length 7.5 mm., width 2.5 mm.

*Type locality*.—Portobelo, Panama.

*Type*.—U.S.N.M. No. 57165.

*Remarks*.—Described from a single specimen reared from a pupa collected in the bark of an unrecognized tree at the type locality, March 1911, by E. A. Schwarz.

This species resembles *Dromaeolus ornatulus* Horn but differs from that species in being larger, in having the elytra and abdomen reddish brown and the clypeus carinate at the base, and in not having the white pubescence extending along the lateral margins of the elytra or the elytra striate.

**DROMAEOLUS PANAMENSIS, new species**

Oblong, moderately convex, slightly shining, dark brown, the legs and antenna yellowish brown, rather densely, uniformly clothed above with short, semierect, brownish hairs, and beneath with short, recumbent, yellowish hairs.

Head nearly flat, densely, coarsely ocellate-punctate, slightly depressed near interocular carina, which is strongly elevated, arcuate, and not interrupted at middle; clypeus very narrow at base, one-third as wide as distance to eye, not carinate, broadly rounded at apex, the surface coarsely, confluent ocellate-punctate. Antenna rather robust, densely pubescent, vaguely, longitudinally carinate, compact, not serrate; third segment slightly longer than second; segments 3 to 10 slightly longer than wide and subequal in length to one another; segment 11 oblong, subacute at apex.

Pronotum distinctly wider than long, strongly convex, deflexed along base, without distinct depressions or carinae; sides arcuately converging from bases to apices; surface densely, coarsely ocellate-punctate.

Elytra moderately convex; sides converging from bases to tips, which are conjointly broadly rounded; surface finely striate, intervals flat, densely, finely rugose basally, finely, sparsely, punctate toward apices.

Body beneath finely, densely punctate on abdomen, more coarsely ocellate-punctate on prosternum, mesosternum, and metasternum; antennal grooves marginal, narrow, equal in width for their entire length; prosternal suture not deeply grooved; propleural triangle with posterior margin shorter than inner margin; posterior coxae strongly expanded internally.

Length 3.4 mm., width 1.3 mm.

*Type locality*.—Cabima, Panama.

*Type*.—U.S.N.M. No. 57166.

*Remarks*.—Described from a single specimen collected at the type locality on May 28, 1911, by August Busck.

This species is allied to *Dromaeolus moerens* Horn but differs from the description given for that species in being dark brown, with the legs and the antennae yellowish brown, and in having the third segment of the antenna subequal in length to the fourth, the elytra rugose at the bases, and the pronotum distinctly wider than long.

### Genus FORNAX Laporte

#### FORNAX POEYI, new species

Elongate, subcylindrical, strongly convex, slightly narrowed posteriorly, moderately shining, reddish brown, anterior margin of pronotum more reddish, and legs and antennae brownish yellow, rather densely, uniformly clothed with short, recumbent, yellowish hairs.

Head strongly convex, without depressions or carina, coarsely, confluent ocellate-punctate, and more or less granulose; interocular carina strongly elevated, not extending on base of clypeus; clypeus at base slightly wider than distance to eye. Antenna slender, extending slightly beyond base of elytra, not distinctly serrate; segment 2 subequal in length to segment 4; segments 4 and 5 united longer than 6; the following segments subequal in length to one another; segment 11 oblong narrowly rounded at apex.

Pronotum slightly wider than long; sides nearly parallel from base to apex; posterior angles acute; disk moderately convex, without depressions or median carina; surface rugose and finely, confluent ocellate-punctate.

Elytra moderately convex; sides parallel to behind middle, then gradually, arcuately narrowed to tips, which are conjointly narrowly rounded; surface finely striate, finely, densely granulose basally, becoming more sparsely, finely punctate toward apices; epipleura punctate, not grooved.

Body beneath rather densely punctate, finely on abdomen, coarsely on prosternum, and rugosely on metasternum; last abdominal sternite coarsely granulose toward apex; antennal groove narrowed by eye, deep, not half as wide as propleural triangle, not wider in front, the inner margin not very sharply defined; prosternal process flat, sides nearly parallel to behind coxae, acute at apex; first segment of posterior tarsus subequal in length to the following segments united.

Length 4.5 mm., width 1.25 mm.

*Type locality*.—Cayamas, Cuba.

*Type*.—U.S.N.M. No. 57167.

*Remarks.*—Described from a single specimen collected at the type locality, January 24, by E. A. Schwarz.

This species is allied to *Fornax badius* (Melsheimer) but differs from that species in being smaller and in having the head and pronotum finely, confluent punctured, and the inner margin of the antennal suture on the prosternum not very sharply defined.

FORNAX VALERIO, new species

Oblong, subcylindrical, moderately convex, slightly narrowed posteriorly, uniformly dark, reddish brown, the legs and antennae slightly paler, densely clothed above with moderately long, recumbent and semierect, brownish-yellow pubescence, which does not conceal the surface, beneath with shorter and less conspicuous pubescence.

Head convex, without depressions or longitudinal carina, finely, confluent punctate, finely rugose; interocular carinae slightly elevated, not extending on base of clypeus, the latter at base slightly wider than distance to eye. Antenna slender, extending to posterior coxa, not serrate; segments 4 to 10 similar, becoming gradually longer toward tip of antenna; segment 2 very small, shorter than 4; segment 3 longer than 4.

Pronotum wider than long; sides parallel posteriorly, arcuately narrowed anteriorly; posterior angles subacute; disk strongly convex anteriorly, transversely, obliquely depressed behind middle, with a short, smooth line in front of scutellum, and a distinct pitlike depression along base on each side at outer angle of scutellum; surface finely, densely granulose, finely, obsoletely rugose anteriorly and toward lateral margins.

Elytra moderately convex; sides parallel to apical third, then slightly narrowed to the tips, which are conjointly broadly rounded, distinctly striate; intervals flat, finely, densely granulose basally, becoming punctate posteriorly; epipleurae smooth, grooved their entire length.

Body beneath finely, densely punctate, more coarsely on prosternum; antennal groove narrowed by the eye, deep, not half as wide as propleural triangle, not wider in front, inner margin sharply defined; prosternal process deflexed and abruptly narrowed behind anterior coxae, acute at apex; last abdominal sternite longitudinally depressed along sides, longitudinally compressed posteriorly, scabrous and acute at apex; first segment of posterior tarsus subequal in length to the following segments united.

Length 11–15 mm., width 3.5–4.5 mm.

*Type locality.*—Chitaria, Costa Rica.

*Type and paratypes.*—U.S.N.M. No. 57168.

*Remarks.*—Described from three specimens (1 type) collected at the type locality, December 4, 1930, by M. Valerio.



This species resembles *Fornax mendax* Bonvouloir and *Fornax obrutus* Guérin, but it differs from both these species in having the pronotum transversely, obliquely depressed behind the middle, with a distinct pitlike depression along base on each side at outer angle of the scutellum, and with the surface finely granulose, and the elytra finely granulose basally, and it also differs from *obrutus* Guérin in having the prosternal process deflexed behind the anterior coxae, and abruptly narrower to the tip, which is acute.

Genus PLESIOFORNAX Bonvouloir

PLESIOFORNAX NIGRINUS, new species

Narrowly elongate, subcylindrical, strongly shining, black, with a faint bluish or greenish tinge, and legs brownish black, sparsely clothed with short, recumbent, inconspicuous hairs.

Head strongly convex, without distinct depressions or carina, rather coarsely, densely punctate; interocular carina not elevated or extending along base of clypeus, which is strongly contracted at base, its width there being less than half the distance to eye, and broadly, sinuately rounded in front. Antenna slender, more robust toward tip, extending to basal fourth of elytra, basal segments slightly longitudinally carinate; segment 2 as long as segment 5; segment 3 much longer than either 2 or 4; segment 4 longer than wide, more than half as long as 5, the following segments becoming gradually longer.

Pronotum as long as wide, strongly convex; sides parallel along basal two-thirds, feebly, arcuately narrowed along apical third; surface very sparsely, finely punctate, with a median, longitudinal depression extending from base to middle of pronotum, the depression becoming broader and deeper posteriorly.

Elytra strongly convex; sides parallel from base to apical third, then arcuately narrowed to tips, which are conjointly broadly rounded; surface rather coarsely, not very densely, irregularly punctate, not striate.

Abdomen finely, densely punctate, more confluent toward apex of last sternite, which is obtusely angulated. Prosternum sparsely punctate on median part, densely on propleural triangle, which is distinctly longer than wide at base; antennal groove deep, smooth, and shining in its entire length; prosternal process broad, flat, without depressions, sides obliquely converging to apex, which is broadly rounded. Posterior tarsus with first segment as long as following segments united; tarsal claws long, slender, slightly swollen near base, but not toothed.

Length 11-13 mm., width 2.5-2.8 mm.

*Type locality*.—Río Hondo, Costa Rica.

*Type and paratypes*.—U.S.N.M. No. 57169.

*Remarks.*—Described from three specimens (1 type). Type and one paratype collected at the type locality by J. Pittier, and one paratype collected at San José, Costa Rica, 1,000 to 1,200 meters, January 15, 1934, by Ferdinand Nevermann.

This species is allied to *Plesiofornax longicornis* Horn but differs from the description given for that species in being shining black with a bluish or greenish tinge and in having the antenna extending only to the basal fourth of the elytra, the pronotum as long as wide, with the sides parallel along the basal two-thirds, the propleural triangle densely punctate, and the first segment of the posterior tarsus as long as the following segments united.

### Genus FARSUS Jacquelin Du Val

#### FARSUS CONVEXUS, new species

Cylindrical, robust, strongly convex, scarcely narrowed posteriorly, subopaque, uniformly reddish brown, sparsely, uniformly clothed with short, semierect, yellowish hairs, which are more recumbent on under-side of body.

Head moderately convex, vaguely depressed behind clypeus, coarsely, confluent ocellate-punctate; interocular carina vaguely elevated, not extending along base of clypeus; clypeus strongly contracted at base, which is nearly as wide as distance to eye, broadly sinuate or rounded in front. Antenna rather robust, extending slightly beyond base of elytra; segment 2 as long as 4, which is one-half as long as 3, the following segments subequal in length to one another except 11, which is longer and oblong; segments 4 to 10 compact, wider than long.

Pronotum slightly wider than long, strongly convex anteriorly, obliquely deflexed along base; sides parallel to near apex, then arcuately rounded; anterior margin broadly rounded, distinctly carinate, the carina curving backward on each side near apical angles; base broadly emarginate in front of scutellum; surface coarsely, densely ocellate-punctate at middle, scabrous toward sides.

Elytra strongly convex, vaguely striate, the intervals rather densely, irregularly punctate; sides parallel to near apices, which are conjointly broadly rounded.

Body beneath densely, coarsely ocellate-punctate; abdomen strongly convex, last sternite broadly rounded at apex. Prosternum with lateral margin strongly elevated posteriorly, obsolete toward apex; supplementary carina sinuate, strongly elevated anteriorly, extending along prosternal suture to middle of propleural triangle. Femora robust. Posterior coxae strongly, angularly expanded internally.

Length 4–6 mm., width 1.25–2 mm.

*Type locality.*—Tabernilla, Canal Zone.

*Type and paratypes.*—U.S.N.M. No. 57170.

*Remarks.*—Described from four specimens (1 type). The type and two paratypes collected at the type locality, May 14–17, 1907, by August Busck, and one paratype taken from an arc-light globe at Ancon, Canal Zone, during April 1911. Under this species is also included a specimen collected at General Ballivian, Salta Province, Argentina, during 1927–28, by G. L. Harrington. This specimen differs from the type only in having the supplementary carina on the prosternum vaguely indicated posteriorly and joined to the lateral carina near the base.

This species is allied to *Farsus oblitus* Horn but differs from that species in being more robust, more convex, and scarcely narrowed posteriorly and in having the antenna shorter, with the segment 2 as long as segment 4, and the following segments wider than long, the pronotum coarsely ocellate-punctate at the middle, the sides of the elytra parallel to near the apices, with the surface irregularly punctate, the femora robust, the posterior coxae strongly, angularly expanded internally, and the supplementary carina on the prosternum strongly elevated anteriorly and extending only to the middle of the propleural triangle.

#### Genus **ARRHIPIS** Dejean

##### **ARRHIPIS CUBANUS**, new species

Elongate, subcylindrical, moderately convex, rather strongly shining, reddish brown, the antenna and legs yellowish brown, rather densely, uniformly clothed with short, semierect, whitish hairs.

Head slightly convex, without depressions or carina, coarsely, deeply, confluent punctate; interocular carina slightly elevated, extending around inner margin of antennal fossa, but not along base of clypeus; clypeus short, at base twice as wide as distance to eye, feebly, broadly rounded in front. Antenna moniliform, slightly thickened toward apex, extending to base of pronotum; segment 3 as long as following two segments united; segments 4 to 10 as wide as long, subequal in length to one another; segment 11 oblong, feebly incised on inner margin, narrowly rounded at apex.

Pronotum as long as wide, widest near apex; sides nearly parallel; anterior margin broadly rounded, the carina extending nearly to lateral carinae; disk slightly flattened at middle, transversely deflexed along base; surface densely, coarsely ocellate-punctate at middle, more densely punctate and rugose toward sides.

Elytra moderately convex; sides parallel from bases to behind middle, then arcuately narrowed to the tips, which are conjointly broadly rounded and terminating into a short spine; surface feebly striate, finely rugose, rather densely, coarsely punctate basally, becoming coarsely asperate toward apices.

Abdomen beneath finely, sparsely punctate; last sternite coarsely, densely punctate at apex, with a transversely oval, densely granulose area. Prosternum, mesosternum, and metasternum rather densely, coarsely ocellate-punctate; antennal groove absent but replaced anteriorly by a smooth, shining space. Metasternal episternum narrow, sides parallel. Posterior coxae large, strongly, triangularly expanded internally.

Length 4.25 mm., width 1.25 mm.

*Type locality*.—Cayamas, Cuba.

*Type*.—U.S.N.M. No. 57171.

*Remarks*.—Described from a single male collected at the type locality, March 6, by E. A. Schwarz.

This species is allied to *Arrhipis lanieri* Guérin but differs from that species in being smaller and of a pale reddish-brown color, and in having the hairs on the elytra shorter, denser, and more uniformly distributed, the outer segments of the antenna compact and as wide as long, and the prosternum flattened in front with the prosternal process triangular between the anterior coxae and knife-shaped behind the coxae.

#### ARRHIPIS INSULARIS, new species

Elongate, subcylindrical, moderately convex, strongly shining, uniformly yellowish brown, antennae and legs slightly paler, sparsely clothed with very short, recumbent, inconspicuous hairs.

Head slightly convex, without depressions or carina, coarsely, rather densely, but not deeply, ocellate-punctate; interocular carina vaguely elevated, extending around inner margin of antennal fossa; clypeus short, at base twice as wide as distance to eye, broadly rounded in front. Antenna moniliform, slightly thickened toward apex, extending slightly beyond base of pronotum; segment 3 nearly as long as following two segments united; segments 4 to 10 vaguely wider than long, subequal in length to one another; segment 11 oblong, narrowly rounded at apex.

Pronotum slightly wider than long, widest near apex; sides nearly parallel; anterior margin broadly rounded, the carina extending nearly to lateral margins; disk convex, not flattened at middle, arcuately deflexed along base; surface coarsely, rather densely ocellate-punctate at middle, more confluent punctate toward sides, intervals vaguely granulose.

Elytra moderately convex; sides parallel from bases to behind middle, then arcuately narrowed to the tips, which are conjointly broadly rounded and terminating into a short spine; surface not striate, coarsely, rather densely punctate, slightly asperate toward apices, the intervals vaguely granulose.

Abdomen beneath sparsely, very coarsely punctate; last sternite with a transversely oval, densely granulose area. Prosternum, meso-

sternum, and metasternum rather densely, coarsely punctate; antennal groove absent but replaced by a smooth, shining space. Metasternal episternum very narrow, wider behind than in front. Posterior coxae not strongly expanded internally.

Length 3 mm., width 0.9 mm.

*Type locality*.—Cayamas, Cuba.

*Type*.—U.S.N.M. No. 57172.

*Remarks*.—Described from a single male collected at the type locality, March 15, by E. A. Schwarz.

This species is allied to *Arrhipis cubanus* Fisher but differs from that species in being yellowish brown, with very short, inconspicuous hairs, and in having the pronotum convex at the middle and not flattened, the outer segments of the antenna vaguely wider than long, the metasternal episternum very narrow, and wider behind than in front, the prosternal process triangular behind the anterior coxae, the pronotum arcuately deflexed along the base, and in not having the elytra striate.

#### Genus DIRHAGUS Laporte

##### DIRHAGUS ALBOFASCIATUS, new species

Elongate, subcylindrical, moderately shining, reddish brown, except legs, which are yellowish brown, the pronotum and elytra ornamented with whitish pubescence.

Head strongly convex, vaguely depressed near clypeus, without longitudinal carina, densely, finely granulose, rather densely clothed with short, erect, inconspicuous, whitish hairs; interocular carina elevated, broadly interrupted at middle; clypeus at base one-half as wide as distance to eye, truncate at apex; eyes large, not incised beneath. Antenna about two-thirds as long as body, strongly pectinate from segment 4 in male, acutely serrate from segment 3, except segment 11, which is narrowly elongate, in female; segment 3 much longer than 2.

Pronotum distinctly wider than long, strongly convex, a short, longitudinal, antescutellar carina with a slight depression on each side; sides parallel; anterior margin arcuately rounded, the anterior supplementary carina strongly elevated, short, not extending to middle of pronotum; surface densely, finely ocellate-punctate, sparsely clothed at middle with short, erect, inconspicuous hairs, and at sides and toward base with long, recumbent, whitish hairs.

Elytra moderately convex; sides slightly converging from bases to tips, which are very broadly conjointly rounded; surface vaguely striate along sutural margins near apices, densely, coarsely, rugosely punctate, sparsely clothed with short, semierect, inconspicuous hairs, and irregularly clothed with longer, recumbent whitish hairs along

bases and sides and forming a more or less distinct broad, transverse fascia behind middle and a broad spot at apices.

Body beneath coarsely, densely punctate, sparsely clothed with short, recumbent, whitish hairs; juxtasutural groove broad, smooth, sharply limited externally; lateral marginal carina sinuate, obsolete posteriorly and curving toward posterior supplementary carina, which is strongly elevated posteriorly, becoming obsolete in front of middle; metasternal episternum narrow, wider behind than in front; posterior coxae slightly expanded internally.

Length 3 mm., width 1 mm.

*Type locality*.—Felton, Cuba.

*Type, allotype, and paratypes*.—U.S.N.M. No. 57173.

*Remarks*.—Described from five specimens (1 male type). The type and allotype were collected at the type locality by W. M. Mann; two paratypes were collected at Baracoa, Cuba, during August 1901, by August Busck; and one paratype was collected at Higueral, Dominican Republic, during February 1916, by E. G. Smyth.

This species is allied to *Dirhagus pectinatus* LeConte but differs from that species in being smaller and in having the pubescence on the pronotum and elytra longer and ornamented with more or less distinct white pubescent designs, the juxtasutural groove smooth, with the sides parallel, the posterior supplementary carina extending to the middle of the pronotum, the antenna in the male pectinate from the fourth segment, and in not having the head longitudinally carinate on the occiput.

#### HYLOTASTELLA, new genus

Body elongate, parallel. Head large, strongly convex; labrum invisible; eyes partially covered by prothorax; clypeus strongly contracted at base. Antenna long, robust, cylindrical, segments compact; second segment very small, the following segment much longer than wide. Pronotum wider than long, lateral margins distinct, entire; anterior margin simple, not carinate. Scutellum subtriangular, longer than wide, narrowly truncate at apex. Propleural triangle longer than wide, without antennal grooves. Marginal carina and prosternal suture of prosternum converging anteriorly, prosternal suture closed, distinct for entire length. Metasternum and abdomen without tarsal grooves. Metasternal epimeron completely covered. Metasternal episternum narrow, sides parallel. Last abdominal tergite not extending over last abdominal sternite, which is narrowly rounded at apex. Posterior coxa suddenly expanded internally, very narrow externally. Legs slender. Tarsi without lamellae; segment 1 of posterior pair as long as following segments united; segment 4 hollowed out on dorsal surface for receiving following segment, truncate at apex.

*Genotype*.—*Hylotastella schwarzi*, new species.

This genus resembles a small species of *Hylotastes* Bonvouloir, but it differs from that genus in being gradually narrowed posteriorly and in having the antenna cylindrical and four-fifths as long as the body, the clypeus broadly rounded in front, the posterior coxa abruptly expanded internally, the propleural triangle longer than wide, the tips of the elytra conjointly broadly rounded, and the last abdominal tergite not extending over the last abdominal sternite.

**HYLOTASTELLA SCHWARZI, new species**

Narrowly elongate, moderately convex, dark brown, slightly paler beneath, with the humeral angles of elytra and prosternum yellowish; body above subopaque, beneath slightly shining; head and pronotum densely clothed with long, recumbent, golden-yellow hairs, the hairs shorter and less conspicuous on elytra and underside of body.

Head strongly convex, without depressions or longitudinal carina, finely, confluent ocellate-punctate; interocular carina strongly elevated, interrupted at middle; clypeus at base one-half as wide as distance between it and eye, broadly, sinuately rounded at apex. Antenna four-fifths as long as body; segments 3 to 5 subequal in length to one another, the following segments becoming gradually longer to tip of antenna.

Pronotum distinctly wider than long; sides parallel posteriorly, arcuately narrowed anteriorly; disk strongly convex, transversely, narrowly depressed along base, with a distinct round depression on each side in front of middle; surface finely, confluent ocellate-punctate similarly as on head.

Elytra with sides parallel to apical fourth, then arcuately narrowed to the tips, which are conjointly broadly rounded; surface finely, distinctly striate, the intervals finely, densely granulose.

Body beneath very finely, densely punctate; last abdominal sternite slightly gibbose and coarsely granulose toward apex.

Length 5.75–7 mm., width 1.5–2 mm.

*Type locality*.—Portobelo, Panama.

*Type and paratypes*.—U.S.N.M. No. 57174.

*Remarks*.—Described from three specimens (1 type) collected at the type locality, the type and one paratype collected March 1, 1911, by E. A. Schwarz, and one paratype collected February 20, 1911, by August Busck.

**Genus NEMATODES Berthold**

**NEMATODES EXIGUUS, new species**

Elongate, subcylindrical, moderately convex, strongly attenuate posteriorly, slightly shining, dark brown, nearly black, except legs and antennae, which are reddish brown, rather densely, uniformly

clothed with short, recumbent, yellowish hairs, which are finer on underside of body.

Head rather strongly convex, vaguely depressed near clypeus, coarsely, densely ocellate-punctate; interocular carina scarcely elevated, not extending along inner margin of antennal depression; clypeus slightly narrower at base than distance to eye, strongly sinuate at apex. Antenna robust, slightly expanded toward apex, extending to base of elytra; segment 2 slightly longer than 4; segment 3 longer than 6 and subequal in length to 4 and 5 united; segments 7 to 9 slightly longer than wide; segment 11 oblong, acute at apex.

Pronotum slightly wider than long, widest near middle; sides vaguely narrowed posteriorly, arcuately narrowed anteriorly; posterior angles acute, not carinate or divergent; disk convex, with a vague, round depression on each side in front of middle, sometimes without depressions, rarely with a longitudinal median, smooth space; surface densely, finely punctate on median part, finely rugose toward sides.

Elytra moderately convex; sides nearly parallel along basal half, strongly attenuate posteriorly to the tips, which are rather broadly, conjointly rounded; surface vaguely striate, the sutural stria more distinct, intervals flat, densely, finely punctate basally, the punctures becoming sparser toward apices.

Body beneath finely, densely punctate, the punctures coarser on prosternum; antennal groove broad, shallow posteriorly, deeper anteriorly, not limited internally by a carina, but sometimes with a short carina at outer margin near eye.

Length 3.5–6 mm., width 0.8–1.75 mm.

*Type locality*.—Cayamas, Cuba.

*Type and paratypes*.—U.S.N.M. No. 57175.

*Remarks*.—Described from seven specimens (1 type) collected at the type locality during February and March, by E. A. Schwarz.

This species is allied to *Nematodes atropos* (Say) but differs from that species in being smaller and in having the pronotum wider than long, with the surface densely, finely punctate at the middle, but without a longitudinal, median depressed line, and the elytra vaguely striate.





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## NEW LANTERNFLIES (FULGOROIDEA) FROM SOUTH AMERICA

By R. G. FENNAH

DESCRIPTIONS are given herein of seven new species of Fulgoroidea in the cixiid genus *Pintalia* Stål, of a new genus and species in the otiocerine Derbidae, and of two new species of *Ateson* Metcalf (Achilidae). All the specimens mentioned, including the types, are in the United States National Museum.

### Family CIXIIDAE

#### Genus PINTALIA Stål

*Pintalia* STÅL, Svenska Vet.-Akad. Handl., vol. 3, No. 6, p. 4, 1862. (Genotype, *P. lateralis* Stål, designated by Muir, Pan-Pacific Ent., vol. 1, pp. 103, 106, 1925.)

This rapidly expanding genus is very compact. The characters by which species may be distinguished include the shape of the carinae of the vertex and of the margins of the frons at its base, that of the anal segment of the male, of the pygofer, aedeagus, and genital styles, and the color pattern on the tegmina. The natural relationship of the included species cannot be assessed with precision until there is evidence to indicate the order of seniority of the variables used in their separation. On current evidence it would seem that the shape of the male anal segment and of the genital styles is slightly more stable than the other characters mentioned, and the writer tentatively groups as follows those species for which the relevant data are available:

Anal segment short, lateroapical lobes narrow, decurved through 130°, genital styles short, subangulate.....	<i>propria</i> group
Anal segment fairly short, not or scarcely deflexed distally, genital styles expanded and spatulate distally.....	<i>ecuadoriensis</i> group
Anal segment long, distally deflexed as far as, but not exceeding, 45°, genital styles long, narrow in ventral view.....	<i>albolineata</i> group
Anal segment asymmetrical, often twisted into a single vertical lamina distally, genital styles short.....	<i>obtorta</i> group
Anal segment as above, genital styles long.....	<i>infuscata</i> group
Anal segment distally deflexed as far as 45°, genital styles short, clublike.....	<i>ornata</i> group
Anal segment shortly deflexed through 45°, styles short, angulate, pointed in ventral view.....	<i>huigrensis</i> group
Anal segment deflexed through 90° or slightly more, genital styles distally expanded, truncate or concave on apical margin.....	<i>bicaudata</i> group
Anal segment as above, very asymmetrical, genital styles rounded at apical margin.....	<i>vomerifera</i> group

The *propria* group includes only this species; the second group includes *ecuadoriensis* Muir and *quadrinaculata* (described below); *albolineata* Muir, by contrast, typifies a large group including *brun-nivenosa* Muir, *latinotata* Muir, *longispinis* Muir, *quadrispinosa* Muir, *fuscocomaculata* Muir, *blairmontensis* Muir, *tumatumariensis* Muir, *fuscipennis* Muir, *albomarginata* Muir, *obscurata* Muir, and two species, *marmorata* and *obliquivitta*, described below; the *obtorta* group, including *obtorta* Muir, *pulchella* Muir, and *fuscocomarginata* Muir, would appear to be quite closely related to the *infuscata* group (*infuscata* Muir, *angustinotata* Muir, and *falcata* (described below)) if judged by the shape of the anal segment; *ornata* Muir is grouped with *altamazonica* Muir and *discrepans* Muir, *huigrensis* Muir is somewhat doubtfully associated with *furcata* Muir, while *bicaudata* Muir, *maculipennis* Muir, and *curvivitta* and *daedala* (both described below) form a fairly closely knit group; *vomerifera* (described below) is placed apart, though it shares characters with the preceding group and with the *obtorta* group, on the ground that the shape of the genital styles and the general structure of the aedeagus differ considerably from those of all the species so far considered.

#### PINTALIA QUADRIMACULATA, new species

#### PLATE 2, FIGURES 1, 7-10

*Male*.—Length, 4.0 mm.; tegmen, 5.9 mm.

Vertex with anterior margin and transverse carina straight, lateral margins of frons not thickened in basal portion.

Fuscous; genae, lateral fields of pronotum, sternum, and legs testaceous. Tegmina testaceous, posterior edge of costal cell, base of cell Sc, basal four-fifths of cell R, cell M, and the larger part of cells Cu<sub>1a</sub> and Cu<sub>1b</sub> deeply infuscate, almost piceous, a white round spot at middle

of common stalk of  $M_1$ , a similar spot at fork of  $Cu_1$ , a third on  $Cu_{1a}$  and a fourth on  $Cu_{1b}$ , a hyaline area parallel to nodal line and just basad of it, a fuscous band overlying nodal line and a similar band of equal width and more clearly defined obliquely traversing apical cells across middle from apex of  $R$  to  $M_3$ , apical margin narrowly fuscous to  $M_3$  then broadly fuscous posteriorly but infusate area interrupted by a large testaceous spot distad of apex of clavus.

Anal segment of male short, not deflexed; lateroapical angles only slightly prominent, very slightly produced ventrally. Pygofer broad with each lateral angle produced in a short narrow lobe, distally rounded. Aedeagus tubular, straight, with three spines arising at approximately same level at base of flagellum, the middle spine porrect, the other two strongly curved. Genital styles in profile angulate at middle with a pointed eminence on dorsal border, spatulate distally with greatest width two-thirds from base.

*Type*.—U.S.N.M. No. 57092.

Described from one male specimen taken at Tumupasa, Bolivia, by W. M. Mann (December 1921). The dark basal field of the tegmina and its ornamentation of four cretaceous spots readily distinguish this species.

**PINTALIA MARMORATA, new species**

PLATE 2, FIGURES 5, 20; PLATE 3, FIGURES 30-32

*Male*.—Length, 4.1 mm.; tegmen, 6.0 mm.

Vertex with anterior margin and transverse carina straight, lateral margins of frons very slightly thickened basally.

Testaceous; frons, genae, lateral fields of pronotum, and mesonotum fuscous. Tegmina ivory-hyaline, marbled dull brown in small irregular spots, with an irregular fascia across apical cells subparallel with apical margin; veins dull brown. Wings hyaline, veins fuscous.

Anal segment of male moderately long, deflexed through  $45^\circ$  distad of anal foramen but not much produced. Pygofer broad, lateral angles large, with dorsal margin slightly concave, ventral margin convex. Aedeagus long, tubular, slightly curved dorsad, with three unequal spines at base of flagellum, one being much longer than the other two, flagellum distally expanded, its dorsal margin continued in a slender curved spine, apex of flagellum somewhat pointed. Genital styles strongly angulate, with a broad-based, pointed eminence dorsally near angle, gradually expanded distally, apical margin obliquely truncate.

*Type*.—U.S.N.M. No. 57093.

Described from a single male specimen collected at light on deck in harbor, Puerta Bolívar, Ecuador, by M. Kisliuk and C. E. Cooley (April 9, 1932). This species is distinguished by the pattern on the tegmina and by the shape of the anal segment, pygofer, and genitalia.

**PINTALIA OBLIQUIVITTA, new species**

PLATE 2, FIGURES 3, 16-19

*Male*.—Length, 4.0 mm.; tegmen, 6.0 mm.

Vertex with anterior margin and transverse carina straight, lateral margins of frons prominently raised but not thickened basally.

Fuscous; sternum testaceous, legs pale fuscous. Tegmina ivory-hyaline, a broad oblique band from base of stigma to apex of clavus, three transverse narrow bars in costal cell, the basal bar extended in a narrow broken fascia to claval suture, a suffusion along nodal line and two S-shaped areas in apical cells of R and M, a pale suffusion over distal part of apical cells, cell Cu<sub>1b</sub> except for a round spot, and two broad bands between claval suture and first claval vein yellowish brown. Wings hyaline, veins testaceous.

Anal segment of male moderately long, distally deflexed through 60°, deflexed part not nearly so long as horizontal part. Pygofer broad, lateral angle about 60°. Aedeagus tubular, a spine one-third from base on left side directed ventrally and anteriorly, a second spine on left side at base of flagellum directed dorsally and caudad, a stout curved spine at middle of dorsal surface directed dorsally and caudad, a longer slender spine on right side at base of flagellum directed ventrally and anteriorly, flagellum with two minute adpressed spines on right side near middle, and a longer somewhat oblique spine at apex. Genital styles angulate near base, with a short broad spine dorsally near angle, distally narrow, slightly expanding caudad, rounded and setigerous at apex.

*Type*.—U.S.N.M. No. 57094.

Described from one male taken at Santo Domingo, southeastern Peru, labeled "collection Rosenberg." This species is distinguished by the genitalia and by the tegminai pattern.

**PINTALIA FALCATA, new species**

PLATE 2, FIGURES 4, 22; PLATE 3, FIGURES 27-29

*Male*.—Length, 4.3 mm.; tegmen, 6.1 mm.

Vertex with anterior margin and transverse carina straight, lateral margins of frons not thickened basally.

Fuscous; tegmina ivory-hyaline, extreme base of tegmina, a broken fascia from costa to junction of claval veins, a second fascia from costa just basad of stigma to commissural margin distad of apex of clavus, nodal line, apex of each apical vein, and a band from third apical cell of M to middle of cell Cu<sub>1a</sub> yellowish brown. Wings slightly infusate, veins dark.

Anal segment of male angulately deflexed beyond anal foramen, twisted into a horizontal lobe distally. Pygofer with lateral angles broadly rounded. Aedeagus tubular, a long straight spine on left

side at base of flagellum, a long curved spine on right side at same level, both directed anteriorly; flagellum with a curved tubular membranous lobe arising at middle and curving to left, a pair of broad unequal spines distally. Genital styles weakly angulate at middle, distal portion somewhat sinuately expanded, a row of minute denticles on inner border distally.

*Type and paratype*.—U.S.N.M. No. 57095.

Described from one male and one female collected in French Guiana by W. M. Schaus.

**PINTALIA CURVIVITTA, new species**

PLATE 2, FIGURES 2, 11-15

*Male*.—Length, 3.9 mm.; tegmen, 5.9 mm.

Vertex with anterior margin and transverse carina straight, lateral margins of frons not thickened basally.

Fuscous; sternum and legs testaceous. Tegmina ivory-hyaline, sparsely marked with yellowish brown on membrane, a broad approximately semicircular band of the same color widely enclosing stigma and reaching posteriorly to  $Cu_{1a}$ ; a band across apical cells of M, apex of  $Cu_{1b}$ , a spot distad of apex of clavus, and a suffusion at middle of claval suture yellowish brown. Wings hyaline, veins testaceous.

Anal segment of male deflexed through  $100^\circ$ , symmetrical, deflexed part almost as long as basal part. Pygofer with lateral angles produced into a short narrow lobe, markedly sinuate at apex. Aedeagus tubular, a short stout spine on dorsal surface one quarter from base, directed dorsally and anteriorly, a second spine of similar shape, though slenderer, dorsally at middle, and a third spine, curved dorsad and caudad, at base of flagellum, a short slender spine at middle on left side directed ventrad and forward, a longer sinuate spine subparallel to it at base of flagellum, flagellum devoid of ornamentation. Genital styles angulately bent at middle, expanded distally, apical margin very shallowly excavate.

*Type*.—U.S.N.M. No. 57096.

Described from a single male taken at Rurrenabaque, Bolivia, by W. M. Mann (November 1921). This species is distinguished by the shape of the anal segment, of the lateral angles of the pygofer and of the genitalia, and by the pattern on the tegmina.

**PINTALIA DAEDALA, new species**

PLATE 2, FIGURES 6, 21; PLATE 3, FIGURES 33-35

*Male*.—Length, 5.0 mm.; tegmen, 6.0 mm.

Vertex with anterior margin straight or slightly curved, transverse carina slightly arcuate on each side of middle line, lateral margins of frons thickened basally.

Anterior portion of vertex, basal three-quarters of frons, distal portion of clypeus, sides of clypeus and genae before eyes, pronotum medially, mesonotum, mesopleurites, and fore and middle legs piceous-brown; posterior portion of vertex, frons in apical quarter and clypeus at base, genae above eyes and around antennae, lateral fields of pronotum and basal half of procoxae ivory to pallid, hind legs and sternum pallid testaceous, abdomen dull fuscous. Tegmina hyaline, basal two-thirds of clavus yellowish, postcubital (first claval) vein dark in middle, a yellowish-brown fascia from two bars at middle of costal cell to commissural margin at level of union of claval veins, a very broad fuscous band transversely across tegmina, enclosing stigma anteriorly and of subequal width throughout, a narrow wedge-shaped band from apical veins of R to penultimate apical cell of M, apical margin expandingly fuscous from Rs, two opalescent-hyaline spots between stigma and apex of clavus between Rs and M and  $M_2$  and  $M_{3+4}$ , respectively, the veins at Mf, M-Cu, and Cu distad of apex of clavus yellow. Wings smoky, veins testaceous.

Anal segment of male deflexed distally through  $80^\circ$ , deflexed portion fully as long as basal, in profile slightly dilated distally, a semi-circular excavation on apical margin at middle. Pygofer with lateral angles shortly produced in a small rounded lobe. Aedeagus tubular, a short, broad-based horizontal spine at middle on right side, and a slenderer spine directed caudad at same level on left side, two long spines at base of flagellum on left side, one curved dorsad, the other sinuately ventrocaudad, flagellum tubular, somewhat tumid at base.

*Type*.—U.S.N.M. No. 57097.

Described from one male taken near Baños, Ecuador, by S. W. Frost (February 20, 1937). This species is distinguished by the shape of the anal segment of the male and of the genitalia and by the pattern on the tegmina.

**PINTALIA VOMERIFERA, new species**

**PLATE 3, FIGURES 36-38**

*Male*.—Length, 4.7 mm.; tegmen, 5.5 mm.

Vertex with apical margin and transverse carina straight, lateral margins of frons not thickened basally.

Testaceous-fuscous; tegmina ivory-hyaline, three brown spots in costal cell, the basal spot extending in a broken fascia faintly across to junction of claval veins, a brown spot over R-M and M-Cu, membrane slightly and unevenly suffused fuscous, vein  $Cu_{1b}$  pallid, a pale spot in middle of cell  $Cu_{1a}$ . Wings very slightly smoky, veins testaceous.

Anal segment of male deflexed distally through  $95^\circ$ , right side dilated, apical margin very oblique, making apex acutely pointed. Pygofer with lateral angles not produced, or, if so, very obtusely.

**Aedeagus** tubular, a stout spine in middle line ventrally curved posteriorly, a deep median keellike lobe ventrally in distal half, a long bladeliike process arising at base of flagellum on right directed ventrally and forward, two unequal spines at base of flagellum on distal side directed dorsally, flagellum with two scroll-like folds. Genital styles weakly angulate at middle, much dilated distally, outer margins strongly convex, inner margin straight or nearly so.

*Type*.—U.S.N.M. No. 57098.

Described from one male taken at Baños, Ecuador, by S. W. Frost (February 29, 1937). This species is distinguished by the shape of the anal segment and of the genitalia and by the pattern on the tegmina.

## Family DERBIDAE

### Tribe OTIOCERINI

#### IQUITOSA, new genus

Vertex longer than wide across base (3:1), disk deeply sunken, lateral margins thickened and pustulate distally, approximated at apex, posterior margin concave; frons linear, clypeus medially carinate; head compressed, in profile produced obliquely upward and anteriorly in an acute angle, almost pointed at tip; antennae subequal to length of head, first joint about as broad as long, second joint flattened, with sides straight, expanding distally, apical margin asymmetrically excavate, a single short vermiform appendage attached at base. Pronotum very short, anterior margin angularly convex, posterior margin still more acutely concave, lateral fields broad, quadrate, median carina present, and a carina on each side between eye and tegula; mesonotum convex, depressed in posterior third, median carina feeble, lateral carinae obsolete except for two flangelike vertical eminences in middle; tegulae relatively large. Tegmina with sides expanding distally, apical margin oblique, costal margin sinuate, with a prominent recurved rounded eminence near base, vein M leaving Sc+R one-seventh from base, Sc+R forking two-sevenths from base, M with five branches reaching apical line of transverse veins, clavus narrowly open, but common claval vein not passing beyond its apex. Wings four-fifths as long as tegmina.

Genotype, *Iquitosa shannoni*, new species.

#### IQUITOSA SHANNONI, new species

PLATE 2, FIGURES 23-26; PLATE 3, FIGURES 39-41

*Male*.—Length, 3.2 mm.; tegmen, 5.0 mm.

Head, pronotum except margins, mesonotum except carina, a patch on each lateral field, and posterior margin brown; median carina of mesonotum and margins of pronotum and mesonotum, sternites, and



legs testaceous to stramineous, except for a narrow fuscous band at apex of profemora and a similar band in middle of protibiae. Tegmina mostly piceous, a dull testaceous spot on each side of piceous costal eminence, apical cells from node to  $M_3$  and intervening veins dull yellow with two fuscous interruptions, middle portion of subapical veins paler than corium, veins of corium chiefly red, basally infusate and interrupted with dull yellow spots. Wings smoky, veins concolorous, margin red.

Anal segment narrow, lateral apical angles slightly deflexed. Aedeagus tubular in basal half, with a minute bicuspidate process near base of flagellum, two stout spines at base of flagellum, one on right side, the other distally, both directed dorsally, a transparent spine on flagellum at middle, apex of flagellum lobate with a large spine below it on left; two small spines on right. Genital styles narrow, membranous dorsally distad of middle, with a scroll-like process in middle of dorsal margin.

*Type*.—U.S.N.M. No. 57099.

Described from one male collected at Iquitos, Peru, by R. C. Shannon (March 1931). The basal reflection of the costal margin recalls the similar modification found in *Sayiana* Ball, but *Iquitosa* differs from Ball's type, with which it has been compared, in the more pointed head, the shape of the antennae, and the shape and venation of the tegmina.

## Family ACHILIDAE

### Subfamily APATESONINAE

#### Genus ATESON Metcalf

*Ateson* METCALF, Bull. Mus. Comp. Zool., vol. 82, No. 5, pp. 367, 369, 1938. (Genotype, *A. marmoratum* Metcalf, *loc. cit.*, p. 369.)

#### ATESON SEMILUTEUM, new species

#### PLATE 3, FIGURES 42-47

*Male*.—Length, 5.5 mm.; tegmen, 8.0 mm.

Frons with lateral margins ampliate and raised between level of antennae and suture, median carina terminating distally against a transverse ridge, median carina of clypeus distinct except at base.

Testaceous; abdominal sclerites infusate. Tegmina yellowish, fuscous at base and chiefly so distad of nodal line, with a pale area in the subapical cells of  $M$  and  $Cu_{1a}$ , transverse veins mostly pale. Wings hyaline at base, smoky near apical margin, veins fuscous.

Anal segment of male short. Pygofer with lateral angles scarcely produced, pointed, slightly falcate, medioventral process twice as broad as long, distally shallowly trilobed, the middle lobe largest.

Aedeagus tubular, slightly tapering distally, perianthrium recurved dorsally at apex into a sinuate spine, penis when everted with two curved spines directed ventrally and two straight spines porrect caudad. Genital styles distally expanded, in profile with apical margin sinuately oblique, dorsal margin sinuately horizontal, folding inward with a short pointed lobe.

*Type*.—U.S.N.M. No. 57100.

Described from one male taken at Pará, Brazil, by P. R. Uhler (coll. No. 132). This species is distinguished by the carination of the frons and by the pattern on the tegmina, as well as by the shape of the genitalia.

**ATESON LUTEOSPERSUM, new species**

PLATE 3, FIGURES 48, 49

*Female*.—Length, 7.0 mm.; tegmen, 8.5 mm.

Lateral margins of frons not much raised above level of disk, disk of vertex scarcely depressed, margins scarcely raised.

Vertex, frons, clypeus, pronotum, and mesonotum fuscous, heavily speckled with yellow spots, genae testaceous, sternum and legs fuscous. Tegmina fuscous, heavily marbled and spotted with yellow on membrane, a small patch basad of stigma and over junction of claval veins yellow, corium wholly fuscous, veins spotted with yellow. Wings smoky, veins fuscous.

Ovipositor with first valvulae bearing two teeth dorsally near apex and a curved apical spine; apex of second valvulae rounded in profile. Genital chamber (bursa copulatrix) with three pairs of sclerotized plates, each of the posterior pair, in dorsal view, elongate-quadrate, each of the middle pair larger, curved and triangular, each of the third (dorsal) pair small, narrow, sinuately tapering as shown in figure.

*Type*.—U.S.N.M. No. 57101.

Described from one female taken at Cabima, Panama, by A. Busck (May 28, 1911). This species is distinguished by the weak carination of the frons and vertex, by the shape of the second valvulae of the ovipositor and of the sclerites of the genital chamber, and by the distribution of the yellow spots on the tegmina.

**ATESON MARMORATUM Metcalf**

PLATE 3, FIGURES 50-54

*Ateson marmoratum* METCALF, Bull. Mus. Comp. Zool., vol. 82, No. 5, p. 369, 1938.

For comparison with the preceding species figures are given of the male genitalia of a paratype specimen and of the distinctive portions of the female genitalia.

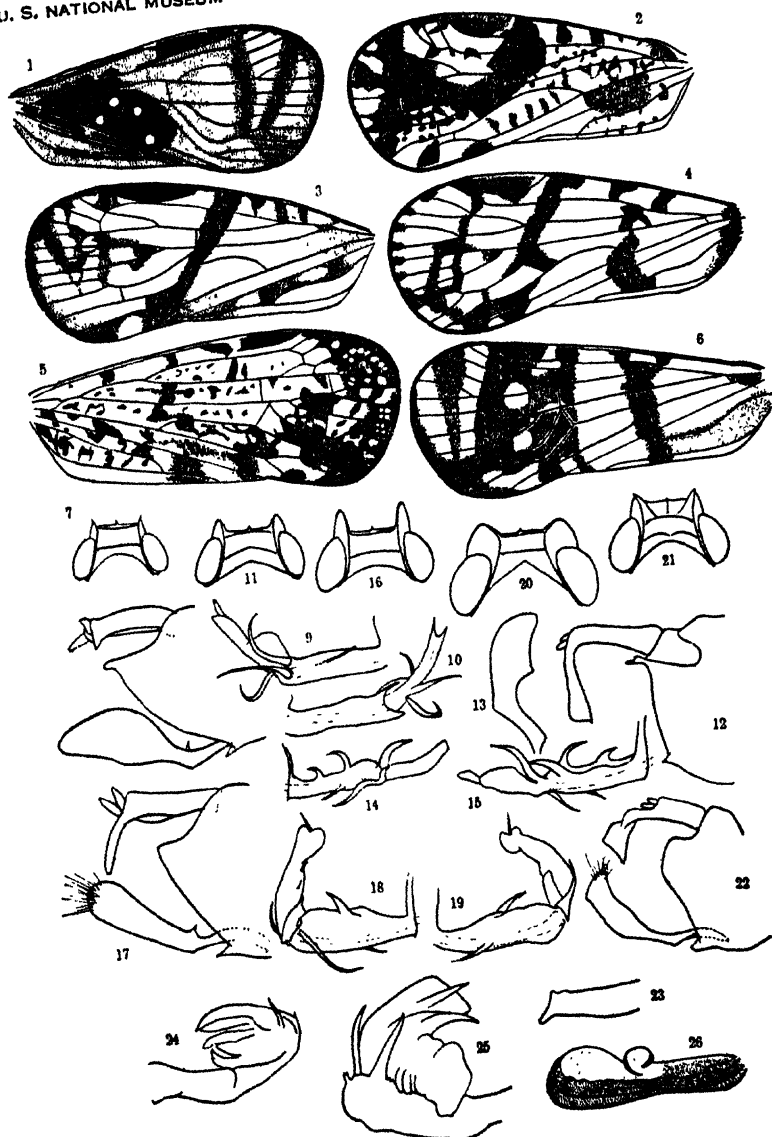
## EXPLANATION OF PLATES

### PLATE 2

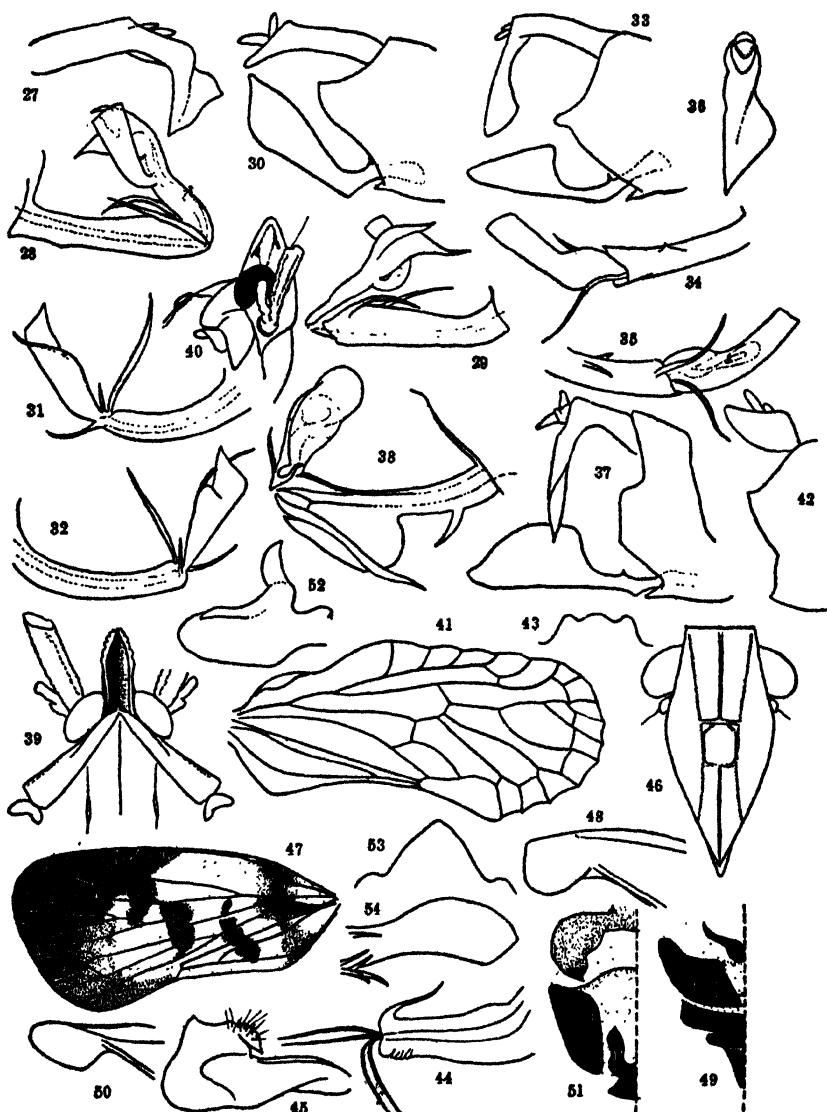
- 1, 7-10, *Pintalia quadrimaculata*, new species: 1, Tegmen; 7, vertex; 8, anal segment, pygofer, and right genital style; 9, aedeagus, right side; 10, aedeagus, left side.  
2, 11-15, *Pintalia curvirostris*, new species: 2, Tegmen; 11, vertex; 12, anal segment and pygofer; 13, right genital style; 14, aedeagus, left side; 15, aedeagus, right side.  
3, 16-19, *Pintalia obliquirostris*, new species: 3, Tegmen; 16, vertex; 17, anal segment, pygofer, and right genital style; 18, aedeagus, right side; 19, aedeagus, left side.  
4, 22, *Pintalia falcata*, new species: 4, Tegmen; 22, anal segment, pygofer, and right genital style.  
5, 20, *Pintalia marmorata*, new species: 5, Tegmen; 20, vertex.  
6, 21, *Pintalia daedala*, new species: 6, Tegmen; 21, vertex.  
23-26, *Iquitosa shannoni*, new genus and species: 23, Anal segment, side view; 24, aedeagus, left side; 25, aedeagus, right side; 26, right genital style, side view.

### PLATE 3

- 27-29, *Pintalia falcata*, new species: 27, Anal segment, left side; 28, aedeagus, left side; 29, aedeagus, right side.  
30-32, *Pintalia marmorata*, new species: 30, Anal segment, pygofer, and right genital style; 31, aedeagus, right side; 32, aedeagus, left side.  
33-35, *Pintalia daedala*, new species: 33, Anal segment, pygofer, and right genital style; 34, aedeagus, right side; 35, aedeagus, left side.  
36-38, *Pintalia vomerifera*, new species: 36, Anal segment, posterior view; 37, anal segment, pygofer, and left genital style; 38, aedeagus, right side.  
39-41, *Iquitosa shannoni*, new genus and species: 39, Head and pronotum (right antenna incomplete); 40, head in profile; 41, tegmen.  
42-47, *Ateson semiluteum*, new species: 42, Anal segment and pygofer; 43, medioventral process of pygofer; 44, aedeagus (everted), right side; 45, right genital style; 46, head, frontal view; 47, tegmen.  
48, 49, *Ateson luteospermum*, new species: 48, Right second valvula of ovipositor; 49, sclerotization of genital chamber.  
50-54, *Ateson marmoratum* Metcalf: 50, Right second valvula of ovipositor; 51, sclerotization of genital chamber; 52, right genital style, ventrolateral view; 53, medioventral process of pygofer; 54, aedeagus (retracted), left side.



NEW SOUTH AMERICAN FULGOROIDEA.  
For explanation see page 104.



SOUTH AMERICAN FULGOROIDEA.

For explanation see page 104.







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THE GENUS FUNDELLA ZELLER: A CONTRIBUTION  
TOWARD A REVISION OF THE AMERICAN PYRALI-  
DID MOTHS OF THE FAMILY PHYCTIDAE

BY CARL HEINRICH

THIS paper is offered now because two of the species treated have been discovered in the United States, and one of these (*pellucens*) is rated as a bean pest of some importance in the Tropics and may easily become one in our Gulf States. Also, there has been considerable misidentification of at least three of the species due to the wide variability of the markings and the misapplication of the name *pellucens* in economic and taxonomic literature. The species are markedly different in their genitalia, but heretofore these organs have not been figured, nor have the structural peculiarities of the several species been indicated.

The genus is confined to the New World. Five species are recognized of which one is here described for the first time. Two older names are referred to synonymy. The study is based upon material in the United States National Museum, a considerable collection of specimens from Puerto Rico in the Cornell University collection, and a few specimens from the Janse and British Museum collections.

Genus FUNDELLA Zeller

*Fundella* ZELLER, Isis von Oken, vol. 41, p. 806, 1848.—RAGONOT, Mémoires sur les Lépidoptères, vol. 7, p. 210, 1893.—JANSE, Journ. Ent. Soc. South Africa, vol. 4, p. 163, 1941. (Genotype: *Fundella pellucens* Zeller.)

*Ballovia* DYAR, Proc. U. S. Nat. Mus., vol. 44, p. 323, 1913; Insecutor Inscitiae Menstruus, vol. 7, p. 40, 1919. (Genotype: *Ballovia cistipennis* Dyar.)

Antenna of male slightly pubescent, base somewhat enlarged, shaft laterally flattened and very slightly excavate at base (pl. 4, fig. 2).



(except in *ignobilis* and *ahemora*) and with a very small blackish scale tuft in the excavation (except in *ignobilis*); of female slender, simple. Front of male head deeply grooved to hold labial palpi; of female rounded. Labial palpus upcurved, reaching to vertex, clothed with broad appressed scales; in male closely appressed to face, with second segment over three times as long as first and with third segment very short (about one-sixth the length of second); in female with second segment shorter and third about one-third the length of second. Maxillary palpus minute. Forewing smooth; 11 veins, 10 from cell, parallel for some distance but not approximate to stalk of 8-9, 9 short, 6 from below upper angle of cell, straight, 4-5 connate or approximate at base, 3 approximately equidistant from 4 and 2, 2 from before lower angle of cell. Hind wing with 8 veins, 7 and 8 closely approximate beyond cell for less than half their lengths, 4 and 5 long stalked, 3 from stalk of 4-5 or closely approximate for some distance, 2 from near lower angle of cell, cell short, discocellular slanting and slightly curved; in male anal area, involving veins 1a and 1b, thickened and folded under to form a pocket enclosing enlarged scales and hair tufts. Eighth abdominal segment of male bearing a thin, short pair of ventrolateral hair tufts.

Male genitalia with uncus long, curved, strongly sclerotized, constricted at middle and broadly divided at apex (hammer-clawed); gnathos terminating in a short, stout hook or a short, broad plate (*ahemora*); harpe rather short, with clasper; vinculum narrow, short; aedeagus stout with long, stout, projecting, curved spine or spines at apex (except in *argentina*); cornutus a single, strong spine.

Female genitalia without signum (*pellucens*) or with signum well developed and consisting of a large oval or pear-shaped cluster of thornlike spines (*argentina*, *agapella*), or curved sclerotized bands armed with stout, thornlike spines (*ahemora*, *ignobilis*); bursa large; ductus bursae short, broad (narrowest in *agapella*); area surrounding genital opening strongly sclerotized, the dorsal sclerotization in the form of a band connected with the supporting rods of eighth segment collar, and armed with two or four spinelike projections (except in *ignobilis* and some examples of *argentina*); ductus seminalis from caudal area of bursa.

This genus is easily distinguished by its striking male characters: the strongly sclerotized, long-stemmed, bifurcate (hammer-clawed) uncus; the large pocket on anal area of hind wing; the long, embedded labial palpus with very short third segment; and minute maxillary palpus. A similar bifurcate uncus is not found in any other American genus except *Defundella* Dyar. In the type species of the latter (*corynophora* Dyar) the uncus is somewhat produced and exhibits a slight bifurcation at apex; but other species, which must also be

referred to *Defundella*, lack this character. *Defundella* separates readily on other male structures: Its greatly reduced gnathos, strongly hooked, partially free sacculus of harpe, its rounded frons, and the narrow, strongly sclerotized, deeply invaginated pocket of the sternite of the eighth abdominal segment.

In *Fundella* the wing pattern varies so much within any given species that it affords no reliable character for specific identification, and the several species can be separated with certainty only by their genitalia.

## KEY TO THE SPECIES OF FUNDELLA

## MALES

1. Clasper a straight spine; aedeagus simple..... **argentina** Dyar  
Clasper a curved digitus; aedeagus armed with curved, strongly sclerotized spine or spines at or near apex..... 2
  2. With large, strongly sclerotized subanal plate; a cluster of several spines from apex of aedeagus; clasper short..... **pellucens** Zeller  
Without sclerotized subanal plate; no more than two spines from aedeagus at or near apex; clasper long..... 3
  3. Gnathos terminating in a broad plate; aedeagus with a pair of spines from apex..... **ahemora** Dyar  
Gnathos terminating in a short, stout hook; aedeagus with a single spine from below apex. .... **ignobilis**, new species
- 
1. Bursa copulatrix without signum; ductus bursae sclerotized throughout length, sclerotization involving part of bursa adjacent to ductus bursae and ductus seminalis ..... **pellucens** Zeller  
Bursa copulatrix with strong signa; ductus bursae at most only partially sclerotized..... 2
  2. Signa in form of large oval or pear-shaped clusters of spines. **argentina** Dyar  
**agapella** Schaus  
Signa in form of bands bearing stout spines ..... 3
  3. Signa consisting of 2 rather short bands, each armed with a row of long spines; ductus bursae with a strongly sclerotized median collar; a widely spaced pair of long, curved spines from sclerotized area immediately behind genital opening ..... **ahemora** Dyar  
Signa consisting of 2 long, partially fused bands each armed with a row of short, stout, thornlike spines; ductus bursae with median area unsclerotized; no spines adjacent to genital opening..... **ignobilis**, new species

## FUNDELLA PELLUCENS Zeller

PLATE 4, FIGURES 1-4, 6-6a, 7-7c; PLATE 6, FIGURES 15-15a

*Fundella pellucens* ZELLER, Isis von Oken, vol. 41, p. 866, 1848; Horae Soc. Ent. Rossicae, vol. 10, p. 236, 1881.—RAGONOT, Mémoires sur les Lépidoptères, vol. 7, p. 210, 1893.

*Ballovia cistipennis* DYAR, Proc. U. S. Nat. Mus., vol. 44, p. 323, 1913.

*Fundella cistipennis* (Dyar) DYAR, *Insecutor Inscitiae Menstruus*, vol. 7, p. 40, 1919.—WOLCOTT, *Journ. Dept. Agr. Puerto Rico*, vol. 17, pp. 241-255, 1933; *Journ. Agr. Univ. Puerto Rico*, vol. 18, p. 432, 1934; vol. 20, p. 477, 1936.—SCOTT, *Journ. Agr. Univ. Puerto Rico*, vol. 24, pp. 35-47, 1940. (New synonymy.)

*Male*.—Antennal shaft with very small black basal tuft (pl. 4, fig. 3). Palpi, thorax, and forewing grayish fuscous more or less dusted with whitish and with interspersed reddish-brown scales (in many specimens the ground color is reddish brown), giving the moth a distinctly gray or gray-brown appearance to the naked eye. Forewing with a conspicuous, round, darker brown or fuscous spot in the center of the area usually occupied by the antemedian line, this dark spot more or less obscured in some specimens but in typical examples outlined by whitish areas inwardly and outwardly and not reaching to inner margin or costa of the wing; discal mark at end of cell obscure, often absent; subterminal line (when distinguishable) faint, white, indented at vein 6 and at submedian fold; a row of dark spots along termen (present only in specimens having an appreciable dusting of white scales). Hind wing white, translucent, a faint fuscous border along costa and (in some specimens) a fuscous line on termen for a short distance from apex; cilia white; anal pocket yellowish white. Midtibia with a fringe of pale hairlike scales along dorsum. Hind tibia with a rather long and slender tuft of pale (whitish ochreous), hairlike scales from the knee joint (pl. 4, fig. 4).

Alar expanse 19-23 mm.

Genitalia (pl. 4, figs. 7-7c) with a large, strongly sclerotized subanal plate, constricted before and beyond its middle. Harpe with apex notched below costa; clasper short, curved, situated near middle of harpe and armed with several setae at its knobbed apex. Aedeagus with a cluster of several long, curved spines from apex; cornutus long, straight, stout.

*Female*.—Essentially like the male in color and markings except that the dark spot near the base of the forewing is more diffused, sometimes reaching to the costa. Hind wing usually with a dark shade along termen.

Alar expanse 19-24 mm.

Genitalia (pl. 6, figs. 15-15a) with bursa copulatrix finely scobinate but without signum; ductus bursae flattened, broad, twisted and constricted near genital opening, sclerotized throughout, the sclerotization involving bursa adjacent to ductus bursae and ductus seminalis; sclerotized band behind genital opening armed with four long, stout, projecting spines; collar of eighth segment invaginated at dorsal margin to form a sclerotized pocket (pl. 6, fig. 15a).

*Types*.—In British Museum (*pellucens*); United States National Museum (*cistipennis*).

*Type localities*.—St. Thomas, British West Indies (*pellucens*); Barbados (*cistipennis*).

*Food plants*.—*Vigna unguiculata* (cowpeas, black-eyed peas, and garden peas), *Canavalia ensiformis* (sword beans), *Canavalia maritima* (black bean), *Cajan cajan* (pigeon pea), *Phaseolus lunatus* (cultivated and wild lima beans), *Phaseolus* sp. (Brazilian specimens), *Cassia occidentalis* (one reared specimen from McCubbins Mills, Puerto Rico, before me; most records from this last plant are doubtful and probably the result of a misidentification of *Fundella argentina* as *cistipennis*).

*Distribution*.—UNITED STATES: *Florida*, Hobe Sound, Miami, Jupiter, Coconut Grove, Marco Island, Walton, Jensen (U.S.D.A. rearings from lima beans, February 1944), Vero Beach (J. R. Malloch, December 1941). *BARBADOS*. *HAITI*: Damien (December, February). *Port-au-Prince*. *MONTSERRAT* (January). *CUBA*: Santiago, Matanzas. *VIRGIN ISLANDS*: St. Croix (March). *PUERTO RICO*: San Juan, Río Piedras (March-May), Isabella, Cataño (July), Vieques Island (April). *BRAZIL*: Bahia (May), Ceará.

Ninety-six specimens examined.

Zeller had two species before him when he described *pellucens*, and the one he figured (fig. 41b) in *Hornae Soc. Ent. Rossicae* is his "var. b," which is Dyar's *argentina*. Through the courtesy of Messrs. Riley and Tams, of the British Museum, I have been able to examine the genitalia of the male paratype designated "var. b" by Zeller and a typical male *pellucens* of the Zeller material from Maraquita. The latter proved to be what Dyar described as *cistipennis* and the species that has appeared in economic literature under that name. What Möschler and others have identified as *pellucens* could not be determined without a genitalic examination of their specimens. Probably in many instances they had mistaken *argentina* for *pellucens*, since both species occur in the West Indies and Brazil.

According to Scott the favored host of *pellucens* (= *cistipennis*) in Puerto Rico is the cowpea (*Vigna unguiculata*), and the species while frequent in lima beans seldom does serious damage. Potentially it is an insect of economic importance. The larvae are primarily pod borers but also bore into the stems and feed on the flowers of their hosts. They attack, as far as known, only Leguminosae.

#### FUNDELLA ARGENTINA Dyar

PLATE 5, FIGURES 8-SC; PLATE 6, FIGURES 12, 13

*Fundella pellucens* ZELLER (in part, "var. b"), *Isis von Oken*, vol. 41, p. 867, 1848;

*Hornae Soc. Ent. Rossicae*, vol. 16, p. 237, fig. 41b, 1881 (new synonymy).

*Fundella argentina* DYAR, *Insecutor Inscitiae Menstruus*, vol. 7, p. 40, 1919.

*Fundella cucasis* DYAR, *Insecutor Inscitiae Menstruus*, vol. 7, p. 40, 1919 (new synonymy).

*Male*.—Antennal shaft with even smaller black basal scale tuft than that of *pellucens*. Forewing gray without the reddish brown, interspersed scaling characteristic of typical examples of *pellucens*; entire basal area to antemedian line dark fuscous gray (with but very slight dusting of whitish scales toward base in some specimens); this dark basal patch contrasted against the paler gray color of the remainder of the wing, extending from costa to inner margin and bordered outwardly by a narrow whitish line. Otherwise not distinguishable, superficially, from *pellucens*.

Alar expanse 15–20 mm.

Genitalia (pl. 5, figs. 8–8c) without sclerotized subanal plate. Terminal projection of gnathos varying from round to pointed (pl. 5, fig. 8a) at apex. Harpe tapering to bluntly pointed apex; clasper a single, straight, slightly roughened, appressed spine, situated beyond middle of harpe. Aedeagus simple; cornutus a single, straight spine.

*Female*.—Essentially like the male in color and markings except that the basal area of forewing is concolorous with or contrastingly paler than the remainder of the wing. A narrow dark line or a diffused dark shading outwardly bordering the obscure antemedian line.

Alar expanse 15–23 mm.

Genitalia (pl. 6, figs. 12, 13) with signum well developed and consisting of a large pear-shaped cluster of thornlike spines; sclerotized band behind genital opening, divided in the middle, simple (pl. 6, fig. 12) in Argentinian and Brazilian specimens, or armed with a pair of median, spinelike projections (pl. 6, fig. 13), rather long in West Indian specimens or short and disappearing in Mexican and Venezuelan specimens.

*Types*.—In United States National Museum (*argentina* and *eucasis*).

*Type localities*.—Tucumán, Argentina (*argentina*); Caracas, Venezuela (*eucasis*).

*Food plant*.—*Cassia* spp. (reared examples in National Collection from *Cassia bicapsularis* and *C. corymbosa*).

*Distribution*.—UNITED STATES: *Florida*, Biscayne Bay (May), Coconut Grove (April); *Texas*, Brownsville (November). MEXICO: Several examples reared from pods and blossoms of *Cassia bicapsularis* at Brownsville, Tex., quarantine station. CUBA: Baraguá (March), Habana, Matanzas, Santiago Province. PUERTO RICO: Bayamón (March, September), Vieques Island (April, July), Coamo Springs (April), Aguirre Central (August), San Germán (August), San Juan (November). HAITI: Pétionville (June). JAMAICA. VENEZUELA: El Valle (June). BRAZIL: Bahia (May). ARGENTINA: Tucumán (March).

Seventy-three specimens examined.

In collections this species has appeared most frequently under the name *pellucens*. Both *argentina* and *pellucens* have about the same distribution and are abundant in the West Indies, though, from material at hand, *pellucens* seems to be rarer on the mainland. Throughout its range *argentina* shows considerable variation in female genitalia. West Indian specimens have rather conspicuous spinelike extensions of the sclerotized band behind the genital opening. These are entirely lacking in Brazilian specimens, and if one had only these extremes he would be justified in assuming that they were at least racially distinct. However, Venezuelan and Mexican examples show an intermediate form with very short projections, and Central American specimens, when recovered in sufficient numbers, will probably show all intergradations. The male genitalia are remarkably uniform throughout the range of the species, exhibiting only minor individual variations in the shape of the terminal projection of the gnathos. The type of Dyar's *cucasis* is only a small, somewhat faded male of *argentina*.

FUNDELLA AGAPELLA Schaus

PLATE 6, FIGURE 11

*Fundella agapella* SCHAU'S, Zoologica, vol. 5, No. 2, p. 47, 1923.

*Female*.—Palpi, head, thorax, and forewing whitish gray; dark markings drab gray; transverse antemedian line of forewing white, defined chiefly by its narrow, dark outer border, sharply sinuate, indented a trifle just below costa, more deeply at top of cell and still more deeply at fold below cell; discal dot at end of cell obscure; white subterminal line indented at vein 6 and at submedian fold, bordered inwardly by a distinct dark shade as broad as the white line itself and outwardly by a similar, fainter, dark shading, the latter conspicuous only at apex. Hind wing as in the other species of *Fundella*.

Alar expanse 12 mm.

Genitalia (pl. 6, fig. 11) like those of intermediate examples of *argentina* except that the signum is considerably smaller in proportion to the size of the bursa.

*Type*.—In United States National Museum.

*Type locality*.—Tagus Cove, Albemarle, Galápagos Islands.

*Food plant*.—Unknown.

Known only from the female type. Superficially a distinct species. The female genitalia, however, would indicate that *agapella* is only a race of *argentina*. A male will be needed for exact placement, and until it is available we shall have to treat *agapella* as a species.

## FUNDELLA IGNOBILIS, new species

PLATE 5, FIGURES 9-9d; PLATE 6, FIGURE 14

*Male*.—Antennal shaft without any trace of black basal scale tuft. Otherwise partaking of the pattern markings of both *pellucens* and *argentina*; in some specimens dark basal patch of forewing round and reaching neither costa nor inner margin (as in typical *pellucens*), in majority of specimens, however, basal patch occupying whole basal area (as in typical *argentina*); median and outer areas of wing averaging a trifle paler than in *argentina* and without the reddish-brown scaling of *pellucens*.

Alar expanse 13-20 mm.

Genitalia (pl. 5, figs. 9-9d) with gnathos terminating in a short, stout hook. Harpe with apex truncate; clasper moderately long, curved, and weakly haired at apex. Aedeagus with a single, long, strong, curved spine from below apex; cornutus a short, stout, curved thorn.

*Female*.—Superficially similar to *argentina* except a trifle paler on the average.

Alar expanse 15-22 mm.

Genitalia (pl. 6, fig. 14) without spines adjacent to genital opening. Bursa copulatrix with signa, consisting of a pair of partially fused bands, each armed with a row of short, stout, thornlike spines; ductus bursae short and broad, with median area unsclerotized; eighth segment collar completely sclerotized except for a small, round, transparent spot on midventer, sclerotization extending to and over area behind genital opening.

*Type and paratypes*.—U. S. N. M. No. 57185. Paratypes also in British Museum and in Cornell University and Janse collections.

*Type locality*.—Oaxaca, Mexico.

*Food plant*.—Unknown.

Described from the male type and 2 male and 4 female paratypes from the type locality; 4 male and 8 female paratypes from Tehuacán, Mexico (May, June, July); 3 male and 7 female paratypes from Orizaba, Mexico; 1 male and 6 female paratypes from Córdoba, Mexico (May); 1 female paratype from Guadalajara, Mexico; 1 female paratype from Jalapa, Mexico; 1 male paratype from Cayuga, Guatemala; 1 female from Costa Rica; 1 male and 1 female paratype from Santiago, Cuba (June); 1 male and 1 female paratype from Sierra Miestra, Cuba (May); 1 male paratype from Cuba without other locality label; 1 male paratype from Aguirre Central, Puerto Rico; and 1 female paratype from Pétienville, Haiti. Most of the foregoing were in the National Collection under either *pellucens* or *argentina*. The species is quite distinct and easily recognized in either sex by its genitalia.

## FUNDELLA AHEMORA Dyar

PLATE 4, FIGURE 5; PLATE 5, FIGURES 10-10c; PLATE 6, FIGURE 16

*Fundella ahemora* DYAR, Proc. U. S. Nat. Mus., vol. 47, p. 403, 1914.

*Male*.—Antenna with small black scale tuft at base of shaft. Forewing with no or a very faint dark basal patch (when present covering basal area to antemedian line); antemedian line whitish, very faint; subterminal line white, faint but less obscure than antemedian, without dark borders except for an inner and an outer dark spot at inner margin of wing; veins from cell rather strongly outlined by dark scaling (the most conspicuous superficial character of the species). A thick, dark (brownish) hair tuft covering outer surface of fore tibia (pl. 4, fig. 5), a male character not found in other species of the genus.

Alar expanse 18-23 mm.

Genitalia (pl. 5, figs. 10-10c) with gnathos terminating in a broad tongue-like plate. Harpe somewhat tapering but with apex truncate; a strong tuft of long scales from costa; clasper long, curved, slender, with a few hairs at apex. Aedeagus with a pair of long, curved, flattened spines from apex; cornutus a long, straight, slender spine.

*Female*.—Essentially like the male in color and markings.

Alar expanse 18-23 mm.

Genitalia (pl. 6, fig. 16) with a pair of long, widely spaced, basally curved spines from sclerotized area immediately behind genital opening. Bursa copulatrix with signa consisting of two rather short bands, each armed with a row of long spines. Ductus bursae bulged in the middle and with a strongly sclerotized median collar. Collar of eighth segment partially sclerotized and fused ventrally.

*Type*.—In United States National Museum.

*Type locality*.—Orizaba, Mexico.

*Food plant*.—Unknown.

*Distribution*.—MEXICO: Orizaba, Jalapa, Teapa (December), Córdoba (April, December), Cuernavaca (July). GUATEMALA: Quirigua (March), Cayuga (January, May), Parulha (July). COSTA RICA: Juan Vinas (November).

Nineteen specimens examined.

Superficially the most easily distinguished species in the genus. The large foretibial tuft at once identifies the male, and both sexes can be separated by the rather conspicuous dark outlining of the veins. The veins are similarly dark scaled in the other species, but the contrast of the dark veins against the pale intervenular areas is more marked in *ahemora*.



## EXPLANATION OF PLATES

The drawings of figures 7-7*c*, 8-8*c*, 9-9*d*, 10-10*c*, 11, 12, and 13 for the plates accompanying this paper were made by Mrs. Eleanor A. Carlin, formerly with the Bureau of Entomology and Plant Quarantine. Figures 1, 2, 3, 4, 5, 6-6*a*, 14, 15-15*a*, and 16 were drawn by Mrs. Sara H. DeBord, of the Bureau of Entomology and Plant Quarantine.

### PLATE 4

1-4, 6-7*c*, *Fundella pellucens* Zeller: 1, Side view of male head; 2, basal segments of male antenna, denuded to show depression in shaft; 3, same, showing scale tuft on shaft; 4, hind tibia of male; 6, wings of male showing venation; 6*a*, ventral view of anal pocket of male hind wing, opened to show scale tufts; 7, ventral view of male genitalia with aedeagus omitted; 7*a*, lateral view of tegumen, gnathos, subanal plate, and uncus; 7*b*, aedeagus; 7*c*, sternite and tergite of eighth abdominal segment of male.

5, *Fundella ahemora* Dyar: Tufted foretibia of male.

### PLATE 5

8-8*c*, *Fundella argentina* Dyar: 8, Ventral view of male genitalia with aedeagus omitted; 8*a*, terminal projection of gnathos showing extreme of variation; 8*b*, sternite and tergite of eighth abdominal segment of male; 8*c*, aedeagus.

9-9*d*, *Fundella ignobilis*, new species: 9, Ventral view of male genitalia with aedeagus omitted; 9*a*, lateral view of tegumen, gnathos, and uncus; 9*b*, aedeagus; 9*c*, sternite and tergite of eighth abdominal segment of male; 9*d*, anellus.

10-10*c*, *Fundella ahemora* Dyar: 10, Ventral view of male genitalia with aedeagus omitted; 10*a*, lateral view of tegumen, gnathos, and uncus; 10*b*, aedeagus; 10*c*, sternite and tergite of eighth abdominal segment of male.

### PLATE 6

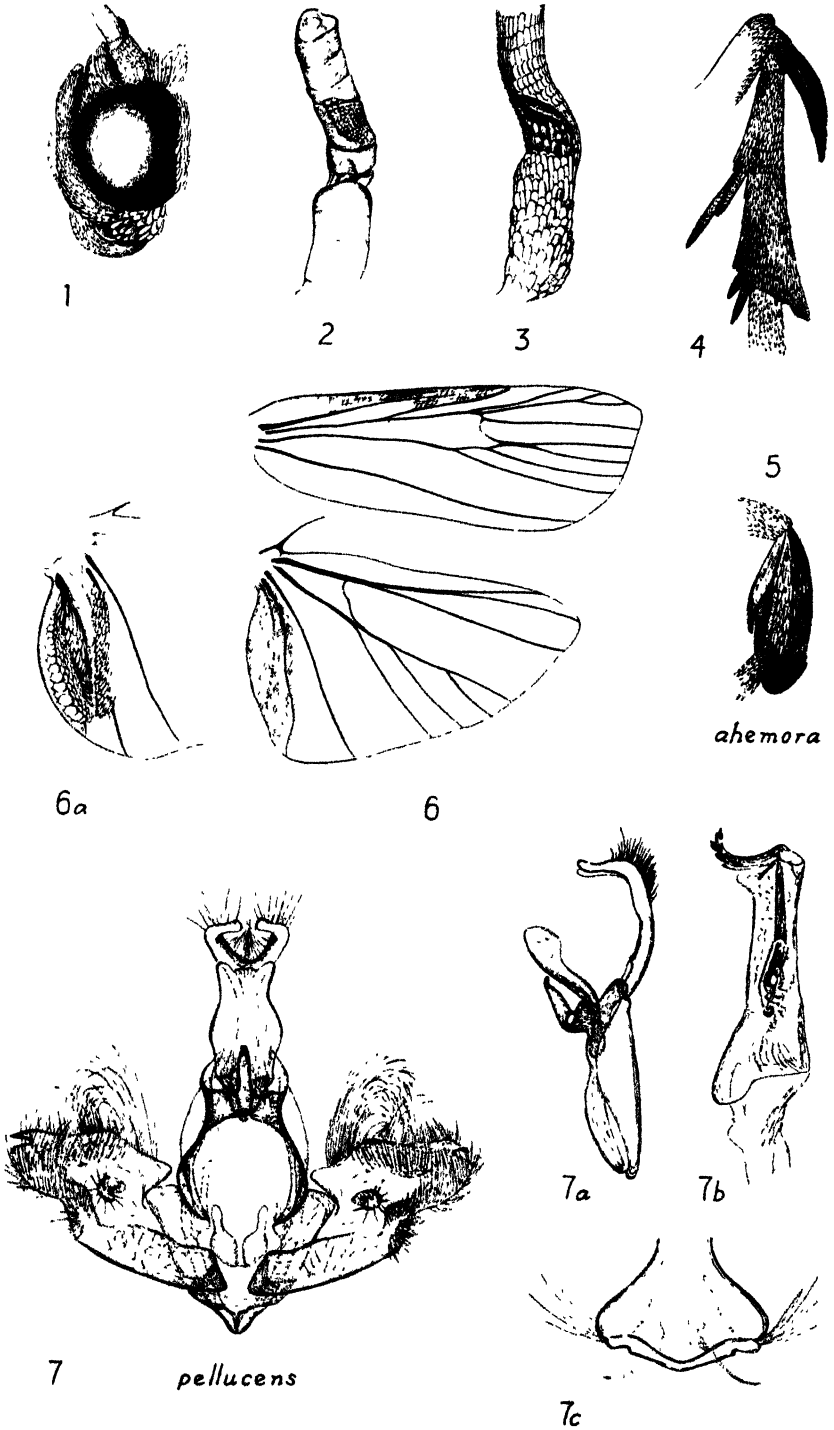
11, *Fundella agapella* Schaus: Ventral view of female genitalia.

12, 13, *Fundella argentina* Dyar: 12, Ventral view of female genitalia of type with bursa copulatrix omitted; 13, ventral view of female genitalia of West Indian specimen.

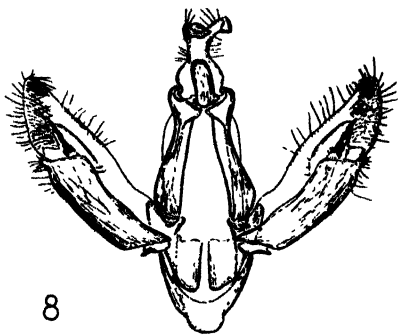
14, *Fundella ignobilis*, new species: Ventral view of female genitalia.

15-15*a*, *Fundella pellucens* Zeller: 15, Ventral view of female genitalia; 15*a*, collar of eighth abdominal segment of female, dorsal view.

16, *Fundella ahemora* Dyar: Ventral view of female genitalia.

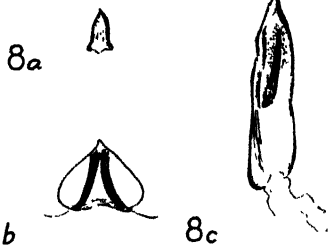


THE GENUS FUNDELLA.  
For explanation see page 114.



8

*argentina*



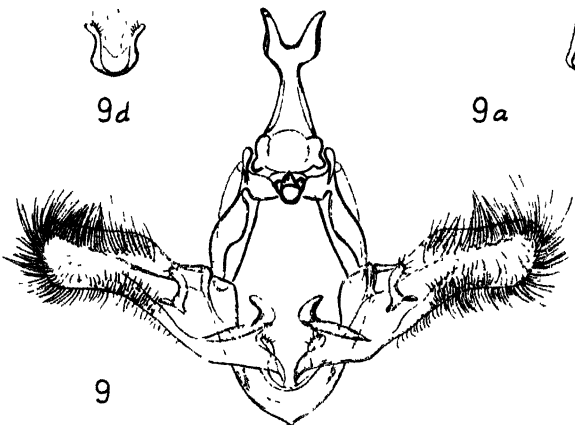
8a

8b

8c

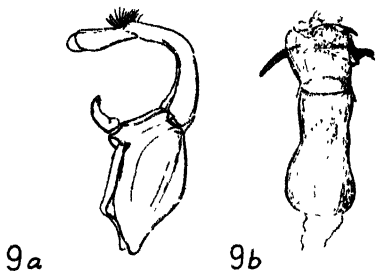


9d



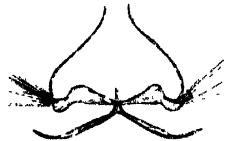
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*ignobilis*

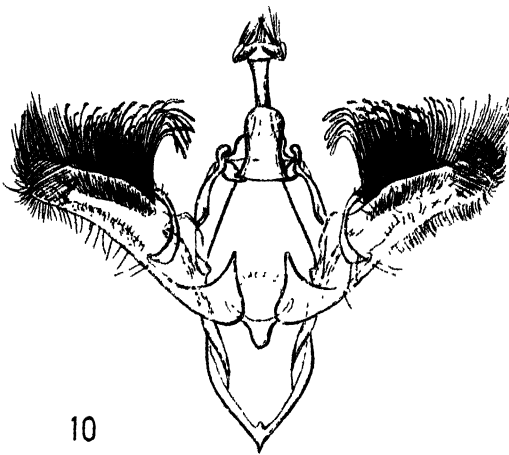


9a

9b

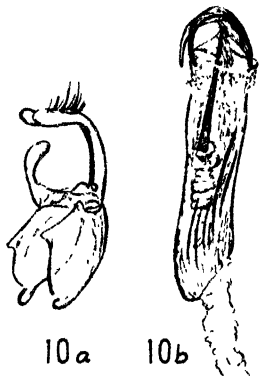


9c



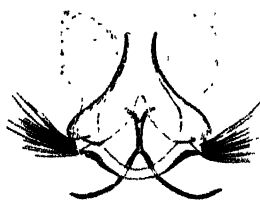
10

*ahemora*



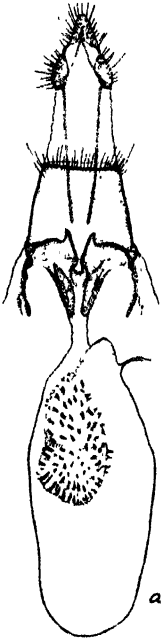
10a

10b

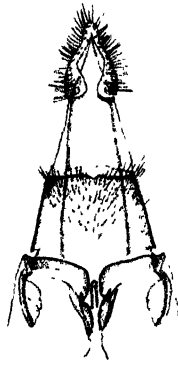


10c

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For explanation see page 114.



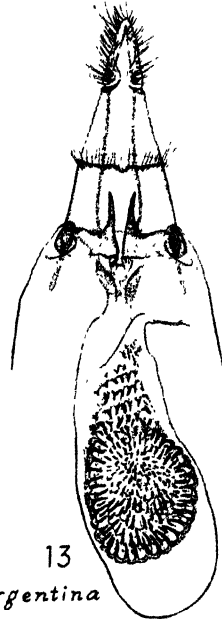
11  
*agapella*



12 *argentina*



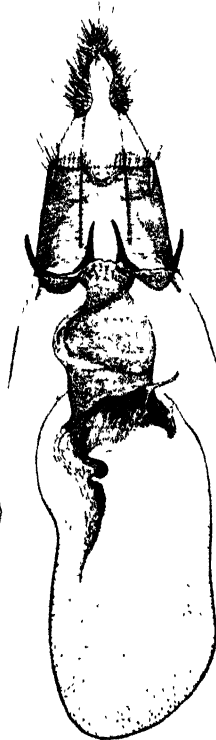
15a



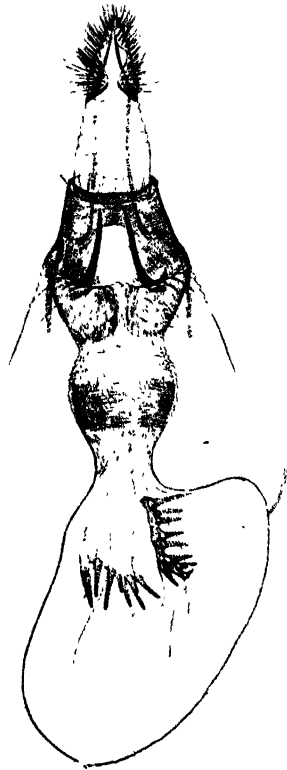
13  
*argentina*



14 *ignobilis*



15 *pellucens*



16 *ahemora*

THE GENUS FUNDELLA  
For explanation see page 114.





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## A NEW GENUS AND TWO NEW SPECIES OF PERCOID FISHES FROM NEW GUINEA, FAMILY CENTROPOMIDAE

By LEONARD P. SCHULTZ

Lt. James R. Simon, U.S.N.R., recently donated to the United States National Museum a small collection of fishes given to him by his friend Capt. Ralph F. Honess, U.S.A., who collected them in New Guinea in 1944. In this lot, totaling 27 specimens, were eight examples from fresh water that I consider to belong to an undescribed percoid genus involving two new species. These are described herein. The other 19 specimens are of known forms occurring in the region.

### XENAMBASSIS, new genus

*Genotype.*—*Xenambassis honessi*, new species.

Body compressed, covered with cycloid scales of moderate size everywhere except on top of head; basal half of caudal fin scaled and a few scales on base of pectoral; lateral line arched over pectoral fin so that it is concurrent with dorsal profile, then extending along midaxis of body posteriorly; each lateral line tube straight, not extending entire length of scale; anterior profile concave over orbits; interorbital space a little convex; a low predorsal ridge extending along middorsal line ending at occiput; mouth terminal, a little oblique; premaxillary slightly protractile; maxillary without supplemental bone, mostly exposed, only the dorsal edge slipping slightly under edge of preorbital bone; maxillary with its posterior edge concave; jaws equal or nearly so, the lower slightly in front of upper; teeth in both jaws in a villiform band, with the outer row consisting of somewhat enlarged conical teeth, the band of teeth becoming narrower on sides of jaw, ending in only one or two rows on lower jaw; vomer with a patch of villiform teeth and palatines with a narrow row of villiform teeth; no teeth on

tongue; cheek and operculum scaled; posterior and lower margins of orbit denticulate and two denticulate ridges on preorbital bone above maxillary, the upper one forming part of the serrae around orbit; preoperculum with double edge, the outer one serrated on both posterior and ventral borders, the inner one serrated at lower angle and a little on each side of the angle above and forward; interoperculum denticulate; operculum not spinate; gill membranes united far forward, free from isthmus; branchiostegals 6; pseudobranchiae present; gill rakers of moderate length, of rather heavy build; a single dorsal fin with the spiny portion scarcely longer than soft portion of VIII or IX spines, the second or third longest, the next to the last shortest; spinous dorsal fin preceded by a short recumbent spine, directed forward, hidden in the skin beneath the scales; anal with 3 spines and usually 10 soft rays; both fins with a sheath of scales along their bases, one scale in width along dorsal and one or two along anal, these fins partly depressible between the sheath; pectorals ii, 13, asymmetrical, upper 2 or 3 branched rays longest; pelvic fins, I, 5, inserted under base of pectorals and a little in front of dorsal origin; pelvic spine slender, not reaching to anus and about two-thirds length of first branched pelvic ray, which ends in a short filament; axillary scale of pelvic small, about length of diameter of pupil; caudal fin forked, lobes more or less pointed.

Other characters are those of the genotype, *X. honessii*, described below.

This new genus is related to the percoid fishes usually referred to the family Centropomidae but sometimes separated from them and grouped in the family Ambassidae or Chandidae. *Xenambassis* is especially close to *Tetracentrum* Macleay, *Synechopterus* Norman, and *Ambassis* Cuvier and Valenciennes, differing from them as indicated in the accompanying key. *Ambassis* differs from the new genus and from *Tetracentrum* and *Synechopterus* by having the first dorsal fin made up of VII spines and joined to the base of the first spine of the second dorsal, whereas in the other three genera the first dorsal is joined at least halfway out the last spine so that the two fins are continuous. *Chanda* Buchanan-Hamilton, 1822, with *C. lala* as the type as restricted by Fowler (Proc. Acad. Nat. Sci. Philadelphia, 1905, p. 500) differs from the above-mentioned genera chiefly in having 14 to 17 soft rays in the anal fin. *Pseudoambassis* Castelnau, 1878 (= *Austrochanda* Whitley, 1935), a substitute name supposed by Whitley to be preoccupied by *Pseudambassis* Bleeker, 1876; and *Velambassis*, proposed by Whitley (Rec. South Australian Mus., vol. 5, No. 3, pp. 356-365, 1935), are here considered as subgenera of *Ambassis* Cuvier and Valenciennes. Indeed, they may even be synonyms of *Ambassis*, since the generic differences appear so slight. I also refer

*Acanthopercu* Castelnau, 1878, and *Blandowskiella* Iredale and Whitley, 1932, as subgenera of *Ambassis*. *Priopidichthys* Whitley, 1935, with teeth on the tongue, may well be a valid genus, as none of the other genera seem to have lingual teeth.

Named *Xenambassis*, meaning a strange or different *Ambassis*.

#### KEY TO THE GENERA AND SPECIES OF NEW GUINEA CENTROPOMIDAE RELATED TO TETRACENTRUM

- 1a. Anal rays IV, 9; dorsal rays IX, 10, dorsal fin continuous; preorbital with 2 serrated ridges; suborbital and postorbital ring of bones with denticulations; inner double edge of preopercular bone strongly toothed at angle and along its lower edge; outer edge of preoperculum strongly denticulate along its entire border; least depth of caudal peduncle  $1\frac{3}{4}$  in its length; profile concave over orbits; pelvics inserted under pectoral base; postorbital length of head 1.1 in length of caudal peduncle.

*Tetracentrum*<sup>1</sup> *apogonoides* (Macleay)

- 1b. Anal rays III, 8 to 11 (see table 1).

- 2a. Dorsal fin continuous, no deep notch in front of last spine, membrane between last two spines connected over halfway out last dorsal spine; second dorsal spine not reaching anywhere near base of last dorsal spine when fin is depressed.

- 3a. Orbital rim without serrae; profile over orbits convex; inner ridge of preoperculum with 1 or 2 serrae at angle; pelvics inserted just behind pectoral base; anal origin under next to last dorsal spine; least depth of caudal peduncle  $1\frac{3}{4}$  in its length; postorbital length of head 1.3 in length of caudal peduncle; dorsal rays IX, 10; 14 gill rakers on lower half of first gill arch; pectoral with 14 rays.

*Synechopterus* *caudovittatus* Norman<sup>2</sup>

- 3b. Orbital rim denticulate; profile over orbits a little concave; inner ridge of preoperculum with lower and posterior sides near angle denticulate; pelvic insertion under pectoral fin base; anal origin under base of last dorsal spine or base of first soft dorsal ray.

- 4a. Dorsal rays VIII, 10 or 11; a blackish band along midaxis of body commencing behind head and becoming more intense on caudal peduncle, its width about equal to that of pupil, ending in a dark blotch at base of caudal fin.----- *Xenambassis* *honesti*, new species

- 4b. Dorsal rays IX, 10; midaxis of body with a narrow dark streak on caudal region not ending in a large dark blotch at base of caudal fin.

*Xenambassis* *simoni*, new species

- 2b. Dorsal fin deeply notched, first portion connected at base of first spine of second dorsal fin; dorsal rays VII-I, 8 to 14; second dorsal spine long, slender, when depressed its tip reaching past base of last dorsal spine.

*Ambassis*<sup>3</sup> *Cuvier* and Valenciennes

<sup>1</sup> Whitley, 1935, proposed *Negambassis* to replace *Tetracentrum*, which he said was preoccupied by *Tetracentron* Brauer, 1865, but the spelling is not in conflict, according to opinions 147 and 148 of the International Commission on Zoological Nomenclature, and so *Tetracentrum* must stand as a valid name.

<sup>2</sup> Copela, 1935, No. 2, pp. 61-63, fig. 1.

<sup>3</sup> For a key to the species of *Ambassis* see Weber and de Beaufort, *Fishes of the Indo-Australian Archipelago*, vol. 5, p. 398, 1929.



## XENAMBASSIS HONESSI, new species

## FIGURE 3

*Holotype*.—U.S.N.M. No. 122830, a specimen 87.6 mm. in standard length, collected in 1944 by Capt. Ralph F. Honess, U.S.A., in either the Samboga or the Girua River at Buna, New Guinea (long. 148° 30' E.; lat. 8°45' S.).

*Paratypes*.—U.S.N.M. No. 122831, 3 specimens, 77.5, 80.5, and 82 mm., collected along with the holotype and bearing same data; U.S.N.M. No. 121832, 2 specimens, 58 and 87.5 mm., bearing same data as holotype.

*Description*.—Detailed measurements were made, and these data, expressed in hundredths of the standard length, are recorded first for the holotype and then for two paratypes in parentheses, respectively. Standard lengths in millimeters 87.6 (82; 87.5).

TABLE 1.—Counts recorded for certain species of *Centropomidae* from New Guinea

Species	Number of fin rays									Number of scales					
	Dorsal			Anal			Pectoral			Lateral line			Above lateral line	Below lateral line	
	VIII, 10	VIII, 11	IX, 10	III, 10	IV, 9		II, 12	II, 13		30	31	32	4	7	8
<i>Tetracentrum apogonoides</i> .....			1		1					1			1	1	
<i>Synechopterus caudovittatus</i> .....			1	1			1					1	1	1	
<i>Xenambassis honessi</i> .....	1	5		6				11	3	3			6	5	1
<i>Xenambassis simoni</i> .....			2	2				4	1	1			2	1	1

Greatest depth of body 46.2 (45.1; 44.6); length of head 37.7 (37.8; 37.4); length of snout 9.25 (9.39; 10.2); diameter of eye 11.0 (11.3; 11.8); least width of interorbital space 9.82 (9.76; 9.02); length from tip of snout to rear tip of maxillary 13.7 (13.4; 14.7); postorbital length of head 18.3 (18.8; 17.7); least width of preorbital opposite tip of maxillary 2.28 (2.20; 2.28); least depth of caudal peduncle 14.4 (14.4; 13.7); length of caudal peduncle from base of last anal ray to mid-caudal fin base 18.8 (18.7; 17.4); length of procumbent embedded spine at origin of dorsal fin 4.56 (4.27; 4.34); length of longest ray of pectoral fin 25.5 (27.1; 25.7); longest soft ray of pelvic fin to end of filament 25.7 (26.8; 25.1); length of pelvic spine 15.6 (16.5; 16.6); length of first dorsal spine 8.10 (6.95; 7.77); of second dorsal spine 19.6 (19.8; 18.3); of last dorsal spine 13.8 (14.5; 15.2) and next to last spine 13.5 (13.0; 13.2); longest soft ray of dorsal fin 20.5 (20.1; 21.7) and of anal fin 21.6 (22.0; —); length of first anal spine 8.56 (6.22; 8.34), of second 12.0 (12.8; 15.6), and of third anal spine 14.8 (14.0; 14.8); longest caudal fin ray 34.2 (33.5; 30.0); shortest midcaudal fin ray 16.8 (17.4; 16.1); length of longest gill raker on first gill arch 3.77 (4.27; 3.65);

distance from tip of snout to dorsal origin 46.8 (47.0; 47.4); snout to anal origin 65.0 (64.3; 65.7); snout to pectoral insertion 34.2 (36.8; 36.0); snout to pelvic insertion 39.0 (39.0; 41.5); snout to center of anus 57.6 (56.7; 52.1); center of anus to anal origin 7.65 (7.32; 8.00).

The following counts were made, respectively: Dorsal rays VIII, 11 (VIII, 10; VIII, 11; VIII, 11; VIII, 11; VIII, 11); anal rays III, 10 in all six specimens; pectoral rays ii, 13 in each side of all six specimens; pelvics always I, 5; gill rakers 6+1+13 in all the types; scales in lateral line 31 (30; 31; 31; 30; 30); scales above lateral line 4 (4; 4; 4; 4; 4) and below lateral line to anal origin 7 (7; 8; 7; 7; 7); zigzag scales around caudal peduncle 15 (16; 16; 16; 15; 16); branched rays of caudal fin always 8+7, totaling 15.

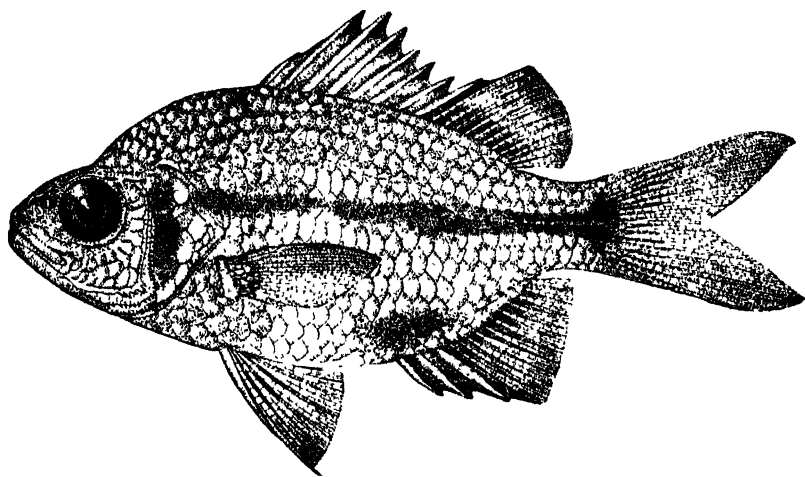


FIGURE 3.—*Xenambassis hunsessi*, new species: Holotype (U.S.N.M. No. 122830), standard length 87.6 mm. Drawn by Mrs. Aime M. Awl.

Depth of body about  $2\frac{1}{4}$ , head  $2\frac{2}{3}$ , both in standard length; snout shorter than eye  $3\frac{1}{5}$  to 4, eye  $3\frac{1}{10}$  to  $3\frac{1}{5}$ , both in length of head; interorbital about equal to snout; maxillary with its rear margin a little concave, not quite reaching to below middle of pupil; three series of scales on the cheek; dorsal origin over rear of base of pectoral fin; first dorsal spine short, second and third of nearly equal length, those following gradually shorter, the next to last spine shortest, about three-fourths length of last; anterior soft rays of both dorsal and anal fins longest, longer than any of the spines in the same fins; first anal spine about two-thirds length of second and third, the latter spine usually a trifle longer than the second; spines of dorsal fin about equal to postorbital length of head; pelvic spine a little shorter than postorbital length of head and the first soft ray a little produced, reaching about opposite the anal origin; pectoral fin nearly or quite reaching to opposite anal origin; vertebrae 10+17.





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THREE NEW SCIAENID FISHES OF THE GENUS *OPHIOSCION*  
FROM THE ATLANTIC COASTS OF CENTRAL  
AND SOUTH AMERICA

By LEONARD P. SCHULTZ

During my studies of the sciaenid fishes of Venezuela I found a specimen of *Ophioscion* (U.S.N.M. No. 86710) from Uruguay, collected by the late Dr. Hugh M. Smith in 1922, with 28 soft rays in the dorsal fin. This count did not agree with the statements of recent authors who have reported on fishes from Panama and from the West Indies under the name of *adustus*. Although Jenyns and Agassiz each counted 28 soft dorsal rays for *adustus* from Maldonado and Montevideo, Jordan and Eigenmann in their review of the Sciaenidae (Rep. U. S. Comm. Fish and Fisheries for 1886, pt. 14, p. 403, 1889) decided that Agassiz's count was incorrect and should have been 22 or 23, or perhaps 18 or 19. Thus the species of the western Atlantic were confused in the first review and the name *adustus* has been applied to two or three Atlantic species.

This contribution discusses the relationships of the western Atlantic species of the genus *Ophioscion* and describes three new species from Panama, Venezuela, and Brazil.

Drawings of figures 6 to 8 were made by Mrs. A. M. Awl.

Genus *OPHIOSCION* Gill

*Ophioscion* GILL, Proc. Acad. Nat. Sci. Philadelphia, vol. 15, p. 165, 1863. (Type: *Ophioscion typicus* Gill, based on U.S.N.M. No. 22861, west coast of Panama.)

No attempt is made to include herein the numerous references to locality records of species of the genus *Ophioscion* from the western

Atlantic Ocean, because this would require a study of the specimens on which such reports were based, and these specimens are not now available.

The genus *Ophioscion* is closely related to *Bairdiella* Gill and *Stellifer* Oken. Meek and Hildebrand (Marine fishes of Panama, vol. 2, p. 611, 1925) separated *Stellifer* from *Bairdiella* and *Ophioscion* in their key on the basis of the skull being "excessively cavernous, spongy to the touch." I had some difficulty separating the various species referred to these genera by this character, and so I made a dissection of the upper surfaces of the skull, removing the scales and skin, thus exposing the nature of the cavernous skull. *Bairdiella chrysura* (Lacepède), *Ophioscion typicus* Gill, and *Stellifer rastrifer* (Jordan) all have cavernous skulls dorsally, and also around the orbits occur narrow bony bridges or stays supporting the overlying skin and scales. *Stellifer* has a broader interorbital space, and thus the caverns are a little broader and by touch can be felt a trifle more easily than the slightly narrower caverns in the other two genera. My dissections indicate that the caverns are well developed in all three genera<sup>1</sup> and are of little value as a diagnostic character in the separation of these three genera, especially if the specimens are well hardened in preservation.

*Ophioscion* is said to differ from *Bairdiella* by having the lower spine of the preopercle pointing straight backward and a little downward, whereas in *Bairdiella* it is said to be hooked downward. The lower preopercular spine in these genera is so variable among the various species of *Bairdiella* and *Ophioscion* that I cast serious doubt on its usefulness as a character. None of the species of *Ophioscion* has any of the preopercular spines hooked downward. However, some individuals, especially young examples of *Bairdiella chrysura*, likewise do not have the lower preopercular spine hooked downward, although in adults of *Bairdiella* that spine is hooked downward.

I have searched for characters to separate these three genera but have found indications of overlapping, and so the following characters are not wholly satisfactory, although the genera can be separated by them when taken together:

*Bairdiella*, with an obliquely terminal mouth; both jaws of nearly same length; lower jaw with minute teeth in a narrow band of two or three rows forward and in a single row of slightly enlarged teeth posteriorly; the pair of small pores at tip of chin close together and lying more or less in a shallow depression (fig. 5, *b*) and the margin of the snout lacking the small lobes at each side of the median pore

<sup>1</sup>I removed the skin and scales from specimens representing various species usually referred to the following genera and found the dorsal part of the skull to be cavernous: *Umbra* Cuvier; *Micropogon* Cuvier and Valenciennes; *Plagtoseion* Gill; *Macrodon* Schinz; *Ophioscion* Gill; *Corvula* Jordan and Eigenmann; *Larimus* Cuvier and Valenciennes. In *Menticirrhus* Gill the caverns were much smaller than in the other genera examined.

(fig. 5, *a*); the gill rakers moderately long and slender, contained less than twice in the diameter of the eye; the first soft ray of the pelvics ending in a filament.

*Stellifer*, with an oblique mouth, somewhat intermediate between *Bairdiella* and *Ophioscion*, a little more inferior in position than in *Bairdiella* but not ventral in position as in *Ophioscion*; the snout projecting a very little in front of the tip of the lower jaw; lower jaw with teeth in a narrow villiform band, the inner row of which is a little enlarged; the pair of small pores near the tip of chin separated by a small bony knob (fig. 5, *d*); the margin of the snout lacking a lobe at each side of the anterior median pore near margin of snout

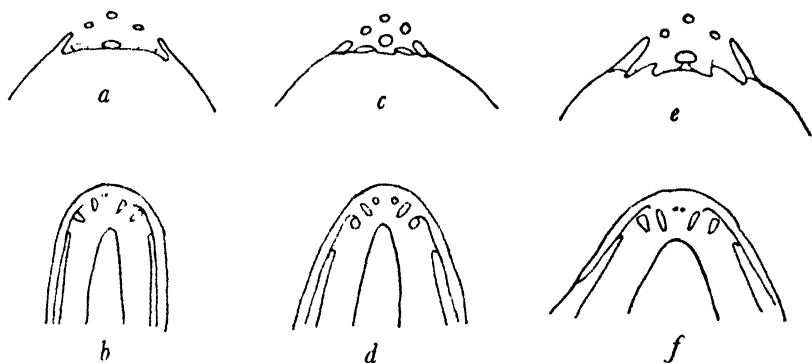


FIGURE 5.—Diagrammatic sketches of the tip of the snout and of the anterior part of the underside of the lower jaw of three species of sciaenid fishes: *a*, Snout tip of *Bairdiella chrysura* (Lacepède); *b*, lower jaw of *B. chrysura*; *c*, snout tip of *Stellifer rastrifer* (Jordan); *d*, lower jaw of *S. rastrifer*; *e*, snout tip of *Ophioscion typicus* Gill (type, U.S.N.M. No. 22861); *f*, lower jaw of *O. typicus*.

(fig. 5, *e*); the gill rakers slender and long, equal to eye or contained in it fewer than two times; the first soft ray of the pelvic fins ending in a filament.

*Ophioscion*, with the mouth in a somewhat ventral position, the lower jaw included and jaws nearly horizontal, with the snout projecting a little beyond the tip of the lower jaw; lower jaw with a wide band of villiform teeth, none of which is enlarged; the pair of small pores at midtip of lower jaw close together and usually lying in a shallow depression (fig. 5, *f*); the front margin of the snout bearing a short, blunt lobe each side of the anterior median pore (fig. 5, *e*); the gill rakers usually short, not slender, and contained more than 2.4 to 6 times in the eye; the first soft ray of the pelvic fins ending in a filament, usually white.

Thorough the courtesy of Dr. Thomas Barbour, of the Museum of Comparative Zoology, I have been able to examine some of the specimens described by Jordan and Eigenmann in 1889 in their review of

the Sciaenidae. "*Stelliferus naso* Jordan," based on specimens from Cachiura, Brazil (M.C.Z. Nos. 4583 and 10808), definitely belongs to the genus *Ophioscion*. Specimens of *Stellifer microps* Steindachner (M.C.Z. Nos. 4581 and 1031), from Pará and Tontoeboá, are *Ophioscion microps* (Steindachner).

Jordan and Eigenmann identified M.C.Z. No. 22417 as *Sciaena adusta* Agassiz, but my reexamination of this specimen indicates that it is *Ophioscion punctatissimus* Meek and Hildebrand.

The following key is intended to separate the species of *Ophioscion* occurring in the Atlantic along the coasts of Central and South America and in the West Indies:

- 1a. Dorsal rays usually X-I, 28 or 29; anal rays II, 8; gill rakers on first gill arch 9+1+16; scales 50 to 57; dark streaks commencing at upper part of back, passing forward and obliquely downward, then a little above lateral line bending abruptly downward, almost vertically, disappearing near mid-axis of body; tip of spiny dorsal fin dark, base of dorsal fin with a narrow pale or whitish band, above which the fin is abruptly darker; opercle dusky (mouth of Río de La Plata)----- *Ophioscion adustus* (Agassiz)
- 1b. Dorsal soft rays fewer than 25.
  - 2a. Anal rays II, 9.
    - 3a. Dorsal rays X-I, 21; gill rakers on first gill arch 8 or 9+1+13, totaling 22 or 23; scales about 45 or 46; eye diameter 1.2 to 1.3 in interorbital space----- *Ophioscion brasiliensis*, new species
    - 3b. Dorsal rays XI-I, 21 or 22; gill rakers on first gill arch 9 to 11+1+17 to 19, totaling 28 to 31; scales about 47 to 51, eye diameter from 1½ to 2¼ times in interorbital space----- *Ophioscion microps* (Steindachner)
  - 2b. Anal rays II, 7 or 8.
    - 4a. Scale rows above lateral line usually 51 to 57.
      - 5a. Gill rakers on lower part of first gill arch usually 16 to 18 including rudiments; dorsal rays XI-I (rarely XII-I) 21 or 22; anal rays II, 8; scale rows 52 to 54; color more or less plain grayish above, paler below----- *Ophioscion venezuelae*, new species
      - 5b. Gill rakers on lower part of first gill arch 11 to 13 (see table for counts).
    - 6a. Dorsal rays X-I (occasionally XI-I), 22 to 24; anal rays II, 7 (rarely II, 6); gill rakers 7 or 8+1+11 to 13; scale rows above lateral line about 54 to 57.
 

*Ophioscion punctatissimus* Meek and Hildebrand
    - 6b. Dorsal rays X-I, 20 or 21; anal rays II, 7 (rarely II, 8); gill rakers 7 to 9+1+13; scale rows above lateral line about 51 or 52.
 

*Ophioscion panamensis*, new species
  - 4b. Scale rows above lateral line 45 to 49; anal rays II, 8; dorsal rays XI-I, 21; gill rakers 8 or 9+1+14 or 15; scales 46 to 49; eye diameter 1.0 to 1.1 in interorbital space----- *Ophioscion naso* (Jordan)

#### OPHIOSCION ADUSTUS (Agassiz)

*Corvina adusta* AGASSIZ, in Spix and Agassiz, *Selecta genera et species* . . . Brasillam . . ., p. 126, 1831 (Atlantic Ocean off Brazil).—JENYNS, *The zoology of the voyage of H. M. S. Beagle*, pt. 4, Fishes, p. 42, 1842 (Maldonado and Montevideo).

*Ophioscion adustus* TORTONESE, *Boll. Mus. Zool. Anat. Comp. Univ. Torino*, ser. 3, vol. 47, No. 100, p. 130, 1939 (Rio de Janeiro and Montevideo).

TABLE 1.—Counts made on species of Ophionichion from the Atlantic coasts of Central and South America

Species	Dorsal										Anal rays										Gill rakers on first gill arch												
	Spines		Soft rays										Anal rays										Above angle					At angle	Below angle				
X-I	XII-I	19	20	21	22	23	24	25	26	27	28	II 6	II 7	II 8	II 9	7	8	9	10	11	1	11	12	13	14	15	16	17	18	19			
2															3																		
7	2					2	3	2						1			2	3				1											
	6	1			5	2								8			2		3			5	1	3	1								
11					5	6								7			2																
					6									1			2		2														
2																	2	1															
	6				6												5	1															
																	6																
5					3	1												2	1														
Number of vertical scale rows above lateral line																																	
45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75			

<sup>1</sup> Counts recorded from U.S.N.M. No. 86710 and from Jennings and Agassiz's descriptions.<sup>2</sup> Counts recorded from U.S.N.M. Nos. 81706 (holotype), 80765 and 80766 (paratypes), 50161, 126188, 104297, M.C.Z. No. 22417.<sup>3</sup> Counts recorded from U.S.N.M. Nos. 81203 to 81207.<sup>4</sup> Counts recorded from U.S.N.M. No. 87712 and 129511.<sup>5</sup> Counts recorded from M.C.Z. Nos. 4583 and 10808.<sup>6</sup> Counts recorded from M.C.Z. Nos. 1031 and 4581.



? *Ophioscion woodwardi* FOWLER, Proc. Acad. Nat. Sci. Philadelphia, vol. 89, p. 311, fig., 1937 (Port-au-Prince, Haiti).

*Corvina adusta* Spix, pl. 70 in Spix and Agassiz (1831), has but X-I, 19 dorsal fin rays and 52 vertical scale rows above the lateral line; the anal rays as shown are II, 7. Obviously Agassiz did not describe the fish figured by Spix, since he gave dorsal rays as X-I, 28 and anal rays II, 9. The most significant character in certain respects as clearly shown in plate 70 is the direction of the scale rows below the lateral line. None are shown parallel with the axis of the body, but the scale rows run obliquely upward and backward to the lateral line and the scale row arising from the rear base of anal fin meets the lateral line just behind a vertical from the rear base of the dorsal fin. The direction of these scale rows strongly suggests that plate 70 in Spix and Agassiz (1831) may be some species of *Plagioscion*, perhaps near *P. pauciradiatus* Steindachner (1917).

The following references list *O. adustus*, but their counts disagree with those for the true *adustus*: Ribeiro, "Fauna Brasiliense Peixes," Arch. Mus. Nac. Rio de Janeiro, vol. 17, family Sciaenidae, p. 23, 1915, and Devincenzi, Ann. Mus. Nac. Montevideo, ser. 2, pt. 5, p. 239, 1924. It must be concluded, therefore, that their descriptions must apply to some other species or that they were erroneously drawn up.

The description by Jenyns fits very well the specimen before me (U.S.N.M. No. 86710), which is 120 mm. in standard length and was collected by Dr. H. M. Smith in Uruguay in 1922.

Berg (Ann. Mus. Nac. Buenos Aires, vol. 4, p. 52, 1895) listed *Sciaena adusta* (Agassiz), but his counts did not agree with those of Agassiz or of my specimen, and they need reexamination to determine the identity of his material.

*Ophioscion woodwardi* Fowler (*loc. cit.*), described from Haiti in 1937, probably is a synonym of *adustus*. I have not seen Fowler's types, but the number of fin rays places it with *adustus*, and the white area along base of dorsal fins abruptly set off by the blackish area distally along basal part of dorsal fin rays, as in our specimen (U.S.N.M. No. 86710) from Uruguay, indicates that *woodwardi* and *adustus* are the same.

#### OPHIOSCION BRASILIENSIS, new species

##### FIGURE 6

*Holotype*.—U.S.N.M. No. 87742, one specimen, 77 mm. in standard length, taken over a sand bar at Santos, Brazil, September 12, 1925, by Dr. Waldo L. Schmitt.

*Paratype*.—U.S.N.M. No. 122611, one specimen, 89 mm., taken with the type and bearing same data.

*Description.*—Certain measurements were made, and these data, recorded below, are expressed in hundredths of the standard length, first for the holotype, then for the paratype in parentheses, respectively. Standard lengths in millimeters, 77 (89).

Length of head 33.8 (33.2); greatest depth of body 32.5 (30.8); diameter of eye 7.53 (7.42); length of snout 9.22 (8.76); distance from front of upper lip to rear tip of maxillary 12.2 (11.8); least preorbital width 4.16 (3.93); postorbital length of head 18.8 (18.4); width of bony interorbital space 9.74 (9.10); length of caudal peduncle or distance from base of last anal ray to midcaudal fin base 22.1 (23.6); least depth of caudal peduncle 10.0 (9.55); length of base of second



FIGURE 6.—*Ophioscion brasiliensis*, new species: Holotype (U.S.N.M. No. 87742).

dorsal fin 32.5 (31.2) and of base of anal fin 12.5 (12.9); longest dorsal spine 17.5 (—); length of second dorsal spine 12.3 (11.8); length of second anal spine 16.2 (13.8); longest ray of pectoral fin 24.4 (22.5); longest soft ray of pelvic fin 25.1 (25.8); length of pelvic spine 12.1 (11.7); longest midcaudal fin ray 26.0 (23.0); length of longest gill raker 3.64 (2.81); distance from snout tip to dorsal origin 37.1 (36.5) and to anal origin 68.3 (70.8); snout to pelvic insertion 35.4 (35.5) and to pectoral insertion 34.4 (33.7).

The following counts were made, respectively: Dorsal rays X–I, 22 (X–I, 21); anal rays II, 9 (II, 9); pectoral rays ii, 16–ii, 17 (ii, 17–ii, 17); pelvics always I, 5; vertical scale rows counted above lateral line 46 (46) and pores in lateral line 45 (46); scales from dorsal origin to lateral line 5 (5) and from base of first soft dorsal ray to lateral line 5 (5); scales from lateral line to anal origin 7 (7); zigzag scale rows around caudal peduncle 17 (17).

Snout bluntly rounded, projecting a little in front of the mouth, the latter inferior in position; lower jaw included; interorbital space broad, a little convex, its width about equal to length of snout; an-

terior profile from dorsal origin to between eyes nearly straight, or a very little convex; ventral profile curves to pelvic insertions, then nearly straight backward to anal origin; body compressed posteriorly; greatest depth of body at dorsal origin; eye  $4\frac{1}{2}$  in head,  $1\frac{1}{2}$  in interorbital space, and  $2\frac{2}{5}$  in postorbital length of head; posterior nasal opening close to eye, larger than the anterior one; tip of lower jaw without barbels but with a median pit containing two minute pores lying in this porelike depression, and laterally two pairs of pores as in *panamensis*; pores and lobes on front of snout as described for *panamensis*; anus a little over two-thirds closer to anal origin than to pelvic bases; tip of filament of pelvic soft ray reaching to anus; pectoral fins reaching to opposite anus; gill rakers moderately short, the longest equal to diameter of pupil; preopercular spines numbering 9 or 10, none hooked downward, those dorsally smaller than those near lower angle of preopercle; skull with the usual cavernous spaces as found in other genera; least depth of caudal peduncle a little more than twice in its length; teeth in villiform bands in both jaws, the outer row of upper jaw a little enlarged; pseudo-branchiae well developed; scales ctenoid; lateral line broadly curved over pectorals, then running a straight course along midaxis of body posteriorly, and extending on the caudal fin; the fourth scale row below lateral line anteriorly is the first one continuing to base of caudal fin; second dorsal spine only slightly heavier (enlarged) than following spines; second dorsal spine  $1\frac{1}{4}$  in second anal spine and reaching more than halfway to tips of third or fourth dorsal spines and  $1\frac{2}{5}$  in postorbital length of head; second anal spine moderately enlarged, and not reaching to tips of soft rays; pelvic spine equal to length of second dorsal spine; distal margins of all fins a little rounded, that of caudal fin double truncate, with the middle rays longest.

*Color*.—In alcohol, pale brownish above, lighter below; anal and spiny dorsal dusky; pelvic soft rays dusky distally, the filamentous ray white; other fins very pale brownish; peritoneum with numerous black pigment cells; the types are not well preserved and the colors have faded.

*Remarks*.—This new species of *Ophioscion* may be separated from other Atlantic species of this genus by the foregoing key.

Named *brasiliensis* in reference to the country along whose shores the types were collected.

#### OPHIOSCION MICROPS (Steindachner)

*Corvina microps* STEINDACHNER. Sitzb. Akad. Wiss. Wien [Ichth. Notizen No. 1], vol. 49, p. 6, pl. 2, fig. 2, 1864 (Gulana).

I have made measurements on two specimens from Pará (M.C.Z. No. 4581), and the results are recorded below in hundredths of the standard length. Standard lengths in millimeters, 66.3 and 60.3.

Length of head 32.1 and 33.2; greatest depth of body 30.2 and 31.5; diameter of eye 6.64 and 6.47; length of snout 9.95 and 8.62; distance from front of upper lip to rear of maxillary 11.3 and 11.9; least pre-orbital width 4.98 and 4.48; postorbital length of head 18.5 and 19.1; bony interorbital space 10.4 and 11.3; length of caudal peduncle or distance from base of last anal ray to midcaudal fin base 26.8 and 24.9; least depth of caudal peduncle 9.95 and 10.1; length of base of second dorsal fin 33.2 and 35.6; length of anal fin base 12.5 and 12.6; length of longest or third dorsal spine 19.6 and 19.8; length of second dorsal spine 14.0 and 13.4; longest soft anal ray 19.6 and 21.5; length of second anal spine 18.1 and 18.6; longest pectoral ray 21.1 and 25.7; longest soft ray of pelvic fin 23.1 and 23.7; length of pelvic spine 12.4 and 13.3; tip of snout to dorsal origin 36.9 and 38.1; snout to anal origin 65.4 and 66.8; snout to pectoral insertion 32.1 and 33.3; length of longest gill raker 2.71 and 2.65.

The following counts were made: Dorsal rays XI-I, 19, and XI-I, 21; anal rays II, 9 and II, 9; pectoral rays ii, 16-ii, 16 and ii, 17-ii, 16; pelvics always I, 5; gill rakers on first gill arch 11+1+19 and 11+1+18; vertical scale rows above lateral line 51 and 50; scales from dorsal origin to lateral line 5 and 5, and from base of first soft dorsal ray to lateral line 4 and 4; scales from anal origin to lateral line 7 and 8; zigzag scale rows around caudal peduncle 18 and 18. Additional counts are recorded in table 1.

This species has a very small eye, smaller than in any other species. Diameter of eye is contained in young  $1\frac{1}{2}$  to  $1\frac{3}{4}$  and in adults 2 to  $2\frac{3}{4}$  times in interorbital space.

OPHIOSCION VENEZUELAE, new species

FIGURE 7

*Holotype*.—U.S.N.M. No. 121749, one specimen, 139.5 mm. in standard length, collected by Leonard P. Schultz near mouth of Caño de Sagua, 25 km. north of Sinamaica, Venezuela, May 12, 1942.

*Paratypes*.—U.S.N.M. No. 121750, six specimens, 57 to 150 mm., collected with the holotype and bearing same data.

*Description*.—Certain measurements were made, and these data, recorded below, are expressed in hundredths of the standard length, first for the holotype and then for the three paratypes in parentheses, respectively. Standard lengths in millimeters, 139.5 (68.8; 150; 139).

Length of head 28.6 (30.5; 32.4; 30.2); greatest depth of body 30.1 (27.0; 31.2; 30.9); diameter of eye 6.24 (7.12; 5.93; 6.11); length of snout 8.74 (8.14; 9.34; 8.63); distance from tip of snout to rear edge of maxillaries 13.1 (12.6; 13.0; 13.2); least width of preorbital 3.65 (3.63; 4.13; 39.5); postorbital length of head 18.0 (15.8; 17.9; 18.5); width of bony interorbital space 9.68 (9.16; 9.66; 10.3); length of caudal pe-

duncle 25.1 (25.1; 24.3; 25.4); least depth of caudal peduncle 10.7 (9.88; 10.9; 10.9); length of base of second dorsal fin 32.6 (32.5; 32.1; 32.4); length of base of anal fin 11.0 (11.6; 11.7; 11.2); length of longest dorsal spine 18.6 (21.1; 18.5; 19.3); length of longest soft dorsal ray — (13.1; —; —; 13.2); longest soft anal ray 16.1 (17.0; —; 14.7); length of second anal spine 16.3 (17.4; —; 15.8); longest pectoral fin ray 25.2 (23.1; 22.7; 25.2); longest soft pelvic ray 13.0 (18.6; 12.3; 13.9); length of pelvic spine 9.32 (11.5; 8.34; 8.85); longest or middle caudal fin rays 25.9 (26.9; 22.7; 25.5); distance from tip of snout to dorsal origin 37.1 (35.9; 38.5; 37.7); snout to anal origin 67.2 (65.4; 65.1; 66.2); snout to pectoral insertion 32.6 (31.1; 32.2; 31.6); snout to pelvic insertion 32.6 (30.5; 30.6; 30.9); length of longest gill rakers on first gill arch 1.58 (2.76; 1.66; 3.22).

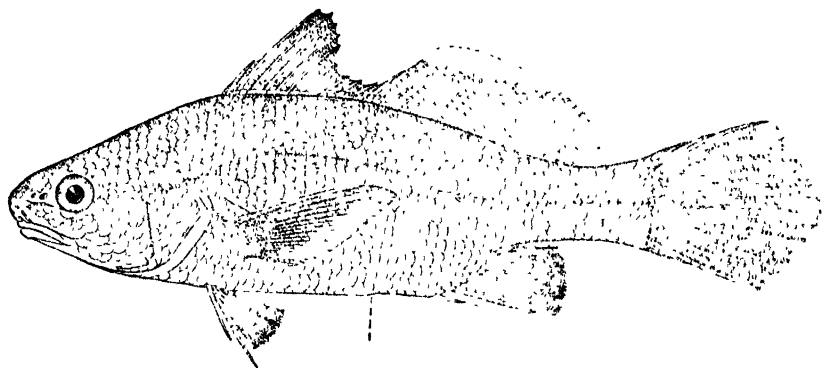


FIGURE 7.—*Ophioscion venezuelae*, new species: Holotype (U.S.N.M. No. 121749).

The following counts were made, respectively: Dorsal rays XI-I, 21 (XI-I, 22; XII-I, 21; XI-I, 21; XI-I, 21; XI-I, 21; XI-I, 22); anal rays on all types II, 8; pectoral rays ii, 17-ii, 17 (ii, 16; ii, 17-ii, 17; ii, 17-ii, 17; ii, 16); pelvics always I, 5; number of vertical scale rows above lateral line 52 (53; 52; 54); scales from dorsal origin to lateral line 6 (—; 6; 6) and from base of first soft dorsal ray to lateral line 6 (—; 6; 6); scales from lateral line to anal origin 8 (—; 8; 8); scales in a zigzag row around the caudal peduncle 19 (—; 19; 19); number of gill rakers on first gill arch 9+1+16 (—; 10+1+18; 10+1+18; 9+1+16; 10+1+16).

Head depressed forward but rounded dorsally, the interorbital space convex, broad, about equal to the snout; body compressed; anterior profile nearly straight but the dorsal contour curved, the ventral contour but slightly curved backward to anus; back highest at base of spiny dorsal fin; eye about  $2\frac{3}{8}$  in postorbital length of head,  $1\frac{4}{5}$  in interorbital space; posterior nasal opening rounded, slightly larger than the anterior one; tip of lower jaw without barbels; anal origin equidistant between pelvic insertion and midcaudal fin base; pelvic

fins reaching halfway to anus, the first soft ray ending in a short filament; preopercle with eight or nine short spines, the lowest one strongest but not hooked downward; caudal peduncle least depth  $2\frac{1}{3}$  in its length; tips of pectoral fins reaching a trifle past anus; teeth in jaws in bands, the outer row of upper jaw a little enlarged; pseudo-branchiae well developed; gill rakers short, not quite so long as pupil diameter; scales strongly ctenoid; lateral line curved over pectoral fin, then running a straight course on caudal peduncle along its midaxis; fourth scale row below lateral line, anteriorly, the first one extending to base of caudal fin; first dorsal spine rudimentary, second  $2\frac{1}{2}$  in third, the latter nearly as long as the fourth; second and eighth to eleventh and the next spine heavier than the third to seventh spines of dorsal fin; fourth or longest dorsal spine about equal to postorbital length of head; distal margin of spiny dorsal fin truncate or a very little concave, that of soft dorsal probably a trifle rounded (the tips of the soft rays are lacking and this cannot be determined accurately); middle rays of caudal fin longest, edges of lobes more or less truncate to rounded (double truncate); distal margins of anal and pelvic fins a little rounded; pectoral fins somewhat pointed, the fourth branched ray from above longest.

*Color*.—In alcohol the upper sides and back are grayish brown, white below; dorsal, anal, and pelvic fins dusky, more intensely pigmented distally; soft dorsal and caudal fins dusky; pectoral fin darker than other fins except tip of spiny dorsal; lower jaw and upper lip white; peritoneum white. In the smaller paratypes the dusky upper sides are broken up with several pale blotches, which appear to have a small cyst at their centers.

*Remarks*.—This new species differs from all other known species of *Ophioscion*, except *O. adustus* and *O. microps*, both from the western Atlantic, in having more numerous gill rakers, 16 to 18 on lower part of first gill arch, but *adustus* has 28 soft dorsal rays and *venezuelae* only 22 to 24. *O. microps* has II, 9 anal rays and *O. venezuelae* II, 8. The key will serve for distinguishing the seven species now recognized in the western Atlantic.

Named *venezuelae* in reference to the country where the specimens were collected.

#### OPHIOSCION PUNCTATISSIMUS Meek and Hildebrand

*Ophioscion punctatissimus* MEEK and HILDERRAND, Marine fishes of Panama, vol. 2, p. 644, pl. 68, 1925 (Cristóbal, Toro Point, and Colon, Panama).

*Ophioscion adusta* EVERMANN and MARSH, Fishes of Porto Rico, U. S. Fish Comm. Bull., vol. 20 (1900), pt. 1, p. 219, 1902 (Vieques Island).

I have examined the following specimens in the national collections:

U.S.N.M. Nos. 81766, the holotype, and 50161 and 126188, four specimens from Vieques Island off Puerto Rico.

U.S.N.M. No. 104297, one specimen, from Recife, Pernambuco, Brazil.

U.S.N.M. Nos. 80765 and 80766, two paratypes, from Panama.

**OPHIOSCION PANAMENSIS, new species**

**FIGURE 8**

*Ophioscion adustus* (in part) MEEK and HILDEBRAND, Marine fishes of Panama, vol. 2, p. 639, 1925 (Fox Bay, Colon, Panama).

*Holotype*.—U.S.N.M. No. 122612, one specimen, 52 mm. in standard length, collected in Fox Bay, Colon, Panama, January 27, 1912, by Meek and Hildebrand.

*Paratypes*.—U.S.N.M. No. 81204, three specimens, 31.5 to 43 mm. in standard length, from Fox Bay, Colon, Panama, January 5, 1911, Meek and Hildebrand; U.S.N.M. No. 81205, four specimens, 23.3 to 30.5 mm., Fox Bay, Colon, Panama, March 31, 1911, Meek and Hildebrand; U.S.N.M. No. 81207, one specimen, 33 mm., from Porto Bello, Panama, March 17, 1912, Meek and Hildebrand; U.S.N.M. No. 81206, one specimen, 42 mm., collected along with the holotype and bearing same data; U.S.N.M. No. 128260, one specimen, 35.5 mm., from Fort Sherman, Canal Zone, Panama, collected March 3, 1937, by Dr. S. F. Hildebrand.

*Description*.—Certain measurements were made, and these data, recorded below, are expressed in hundredths of the standard length, first for the holotype, then for a paratype in parentheses. Standard lengths in millimeters 52 (42).

Length of head 33.3 (34.3); greatest depth of body 32.7 (32.2); diameter of eye 7.30 (7.86); length of snout 9.80 (9.76); distance from front of upper lip to rear tip of maxillary 10.4 (11.4); least preorbital width 4.80 (4.76); postorbital length of head 17.9 (19.0); width of interorbital space 9.62 (10.2); length of caudal peduncle or distance from base of last anal ray to midcaudal fin base 22.3 (23.1); least depth of caudal peduncle 11.2 (10.7); length of base of second dorsal fin 35.4 (35.7) and of base of anal fin 10.6 (11.9); longest dorsal spine 18.3 (16.4); longest soft ray of dorsal fin — (7.2); longest soft ray of anal fin 20.8 (18.6); length of second anal spine 18.8 (19.3); longest ray of pectoral fin 23.1 (22.4); longest soft ray of pelvic 21.7 (25.0) and of pelvic spine 12.1 (12.6); longest midcaudal fin ray 30.0 (31.0); length of longest gill raker 2.11 (2.38); distance from snout tip to dorsal origin 38.3 (39.3) and to anal origin 71.9 (67.4); snout to pelvic insertion 36.0 (35.6) and to pectoral insertion 34.6 (32.9).

The following counts were made, respectively: Dorsal rays X–I, 20 (X–1, 21); anal rays II, 7 (II, 7); pectoral fin rays ii, 17–ii, 17 (ii, 17–ii, 17); pelvics always I, 5; scale rows above lateral line 51 (52) and pores in lateral line to midcaudal fin base 50 (50); scales from dorsal origin

to lateral line 5 (5) and from base of first soft ray of dorsal to lateral line 5 (5); scales from lateral line to anal origin 9 (8); zigzag scale rows around caudal peduncle 19 (17). Additional counts are recorded in table 1.

Snout bluntly rounded, projecting a little in front of mouth, the latter inferior in position, lower jaw included; interorbital space broad, a little convex, its width about equal to length of snout; anterior profile nearly straight from dorsal origin to between eyes or a trifle convex; ventral profile a little convex anteriorly, then nearly straight to anal origin; body compressed posteriorly; greatest depth at dorsal origin; eye about  $4\frac{1}{2}$  in the head,  $2\frac{1}{5}$  in postorbital length of head, and  $1\frac{1}{4}$  in interorbital space; posterior nasal opening close to eye, a

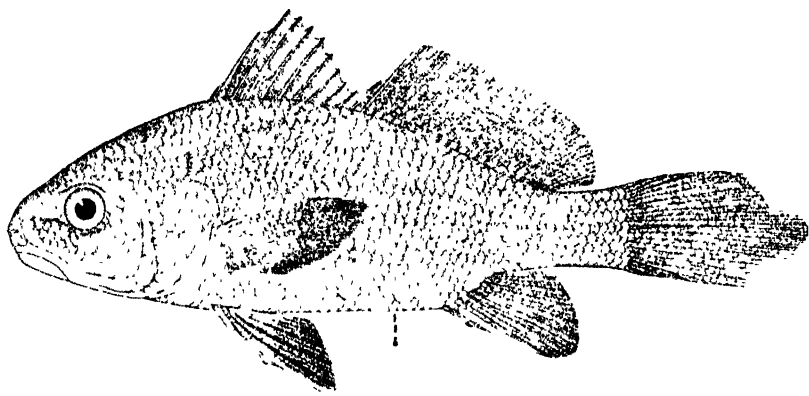


FIGURE 8.—*Ophioscion panamensis*, new species; Holotype (U.S.N.M. 122612).

little larger than anterior one; tip of lower jaw without barbel, but with three pairs of pores, the median pair minute and in a porelike depression; tip of snout with two pairs of lobes, a pore lying between the middle pair of lobes and the outer pair being separated from the median lobes by a pore on each side, a third groovelike pore lying laterally to the outer lobe; then dorsally to the margin of the snout occur a median pore and another pore at each side; anus two-thirds closer to anal origin than to pelvic insertion; pelvic fins not quite reaching to anus; the first soft ray of pelvics ending in a short filament; pectoral fins reaching opposite tip of pelvics; gill rakers short, a little less than one-half the pupil; preopercle with eight or nine small spines, those dorsally smaller than those near the lower angle of preopercle; none hooked downward; skull with the usual open spaces or sinuses between the narrow bony bridges; least depth of caudal peduncle  $1\frac{1}{10}$  in its length; teeth in villiform bands in both jaws, the outer row of upper jaw slightly enlarged; pseudobranchiae well developed; scales strongly ctenoid; lateral line broadly curved over pectorals, then running a straight course along midaxis of body posteriorly, extending on



caudal fin; the fifth scale row below lateral line anteriorly is the first one continuous to base of caudal fin; second dorsal spine enlarged, its length  $1\frac{1}{3}$  in second anal spine, and reaching more than halfway to tip of third or fourth dorsal spine; second dorsal spine  $1\frac{1}{6}$  in post-orbital length of head; second anal spine enlarged, not reaching to tips of soft anal rays; pelvic spine a trifle shorter than second dorsal spine; distal margins of dorsal, anal, and of paired fins a little rounded, that of the caudal fin double truncate, the midcaudal rays longest.

*Color*.—In alcohol the body is brownish everywhere, paler brown ventrally; paired fins and anal and dorsal fins blackish, with the first spine in these fins, except pectorals, whitish; tip of first soft ray in pelvic fins white, especially the filament; soft dorsal and caudal fins brownish with numerous black pigment cells; undersides of head and breast pale; lips pale; peritoneum white.

In the smaller specimens of this species the coloration of the median fins differs from the larger ones. At a standard length of 24 mm. the caudal fin is white, except for a few scattered brown pigment cells located near the center of the fin, the caudal fin base is abruptly dark brown with the pigment extending backward a little on middle rays; the anal and dorsal fins have a brownish band extending across rays, with the margin of the fins white, and below this bar is another white area separating the brownish base of these fins from the brown band; these fins gradually fill in with brown pigment so that at 42 mm. the fins are plain brownish.

*Remarks*.—This new species may be separated from other Atlantic species of *Ophioscion* by the key and traces down to *O. adustus* in Meek and Hildebrand's key to the species of *Ophioscion* in their "Marine Fishes of Panama" (vol. 2, p. 636, 1925).

Named *panamensis* in reference to the region where it has been collected.

#### OPHIOSCIION NASO (Jordan)

*Stelliferus naso* JORDAN, in Jordan and Eigenmann, Rep. U. S. Comm. Fish and Fisheries for 1886, vol. 14, p. 395, 1889 (Cachiura, Brazil).

I have made measurements on two of the types (M.C.Z. No. 4583) from Cachiura, and the results are recorded below in hundredths of the standard length. Standard lengths in millimeters, 75.5 and 70.5.

Length of head 31.1 and 30.5; greatest depth of body 31.8 and 28.4; diameter of eye 8.60 and 9.22; length of snout 9.27 and 9.22; tip of pre-maxillaries to rear of maxillary 10.1 and 9.78; least width of preorbital 3.97 and 3.97; postorbital length of head 15.9 and 15.6; least width of bony interorbital 9.14 and 9.22; length of caudal peduncle (base of last anal ray to midbase of caudal fin) 25.0 and 24.4; least depth of caudal fin 10.6 and 10.8; length of base of second dorsal fin 31.8 and

36.2; length of anal fin base 12.4 and 12.1; length of longest dorsal or third spine 22.3 and 21.0; longest soft dorsal ray 17.2 and —; length of second dorsal spine 10.6 and 11.3; longest soft ray of anal fin 19.9 and 17.9; length of second anal spine 17.0 and 16.5; longest ray of pectoral fin 25.2 and —; longest soft ray of pelvic fins 21.2 and 21.3; length of pelvic spine 12.6 and 12.3; longest or middle rays of caudal fin 28.2 and 28.4; tip of snout to dorsal origin 38.3 and 37.2; snout to anal origin 66.2 and 68.8; snout to pectoral insertion 31.8 and 31.9; longest gill raker 1.99 and 1.99.

The following counts were made, respectively: Dorsal rays XI-I, 21 and XI-I, 21; anal rays II, 8 and II, 8; pectoral rays ii, 16-ii, 16 and ii, 16-ii, 16; pelvics always I, 5; gill rakers on first gill arch 8+1+14 and 8+1+14; vertical scale rows above lateral line 46 and 46; scales above lateral line at origin of spiny dorsal fin 4 and 4, and at base of first soft dorsal ray 5 and 5; scales below lateral line from anal origin to lateral line 8 and 8; zigzag scales around caudal peduncle 18 and 18.





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# THE ICHNEUMON-FLIES OF THE GENUS *CRYPTANURA* BRULLÉ, MAINLY TROPICAL AMERICAN

By R. A. CUSHMAN

BECAUSE of Brullé's mistaken idea that the specimens on which he based the genus *Cryptanura* were females with concealed ovipositors, this genus of ichneumon-flies was misunderstood until Roman (1910) identified it as the male of *Polyaenus* Cresson and synonymized the latter genus with *Cryptanura*.

The genus dates from 1845, when the figure of *Cryptanura nigripes* Brullé was published in the atlas of Lepeletier's "Histoire Naturelle des Insectes," although the description did not appear until the following year. It is therefore a monobasic genus with *nigripes* Brullé as genotype. On this basis, and assuming that *nigripes* and *striata* Brullé are not congeneric, Viereck took exception to Roman's synonymizing of *Polyaenus* Cresson with *Cryptanura*. Viereck's statement that these two species are not congeneric must have been based on the fact that Brullé does not state definitely that *nigripes* has the two small frontal horns characteristic of *striata*; but by inference he certainly does ascribe this character to *nigripes*, for in the description of all the species that follow *striata* he mentions only the characters by which they differ from it and from one another.

Cresson and Cameron were in error in their interpretations of the genus, the species assigned to it by those authors being properly referred to such genera as *Trapezonalis* Szépligeti, *Glodianus* Cameron, *Photocryptus* Viereck, and probably other genera. Roman and Brues appear to be the only ones who have interpreted the genus correctly.

*Cryptanura* is a large genus apparently confined in its distribution to the Western Hemisphere and there very largely to the tropical region, only two species being known to occur north of the Mexican border.

Three species from the Old World Tropics have been referred to *Polyaenus*: *cingulatus* Tosquinet from New Guinea, *spiniferus* Cameron from Borneo, and *striatus* Szépligeti from Formosa, but none appears to be properly referable to the genus. This is certainly true of *cingulatus* and *spiniferus*, for I have been able to identify the latter definitely and the former without much question in the Baker collection. These species represent an apparently hitherto undescribed genus. It is described in an addendum to this paper.

I have been unable to identify *striatus* Szépligeti, but its smooth and polished mesoscutum, longitudinally impressed propodeum with the apophyses apparently represented only by carinae, and elongate postpetiole would seem to exclude it from *Cryptanura*. Aside from the new genus mentioned above, to which *striatus* obviously does not belong, only one other Oriental genus is known to me that has two frontal horns. This is *Ceratocryptus* Cameron, in which *striatus* appears to be equally out of place.

#### SPECIES WRONGLY REFERRED TO CRYPTANURA

The following species described in *Cryptanura* by Cresson and Cameron do not belong to the genus. Unfortunately, most of them are unknown to me. The apparently proper status of the few that I have been able to place is indicated.

(*Cryptanura acolhua* Cresson) = *Glodianus acolhua* (Cresson), new combination.

*C. albispina* Cameron.

*C. cinctipes* Cameron.

*C. curtispina* Cameron.

*C. delecta* Cresson.

*C. fasciatipennis* Cameron.

*C. incauta* Cameron.

*C. interrupta* Cameron.

*C. laticarinata* Cameron.

*C. ornatipennis* Cameron.

(*C. pachymene* Cresson) = *Photocryptus pachymene* (Cresson).

*C. pedicata* Cameron.

(*C. sumichrasti* Cresson) = *Trapezonalis sumichrasti* (Cresson), new combination.

#### Genus CRYPTANURA Brullé

*Cryptanura* BRULLÉ, Histoire naturelle des insectes: Hymenoptera, Atlas. pl. 41, fig. 6, 1845; vol. 4, p. 242, 1846.—ROMAN, Ent. Tidskr., 1910, p. 154.—BRUES, Ann. Ent. Soc. Amer., vol. 5, p. 200, 1912.—TOWNES, Mem. Amer. Ent. Soc. No. 11, pt. 1, p. 288, 1944.

*Polyaenus* CRESSON, Proc. Acad. Nat. Sci. Philadelphia, 1873, p. 149.—CAMERON, Biologia Centrali-Americana, Hymenoptera, vol. 1, p. 244, 1886; Journ. Roy. Agr. Comm. Soc. British Guiana, ser. 3, vol. 1, p. 166, 1911.—SCHMIEDEKNECHT, Genera Insectorum, fasc. 75, p. 67, 1908.—SZÉPLIGETI, Ann. Mus. Nat. Hungarici, vol. 14, p. 264, 1916.—CUSHMAN, Proc. U. S. Nat. Mus., vol. 74, art. 16, p. 38, 1929.

*Polyaenidia* VIERECK, Proc. U. S. Nat. Mus., vol. 46, p. 381, 1913.

*Mesostenus* authors, part.

Head from above transverse, the temples receding; frons with a carina medially and with two small horns, frequently arising from a common base; malar space distinct; clypeus strongly convex; eyes large and strongly convex; antenna in female frequently more or less distinctly thickened between middle and apex, the thickened portion flattened below. Thorax stout; epomia distinct and usually extending to upper margin of pronotum, where they form carinate or conical projections; notaulices deep and complete; scutellum small, usually convex, rarely subconical or flattened; propodeum with basal carina complete, apical carina usually represented only by two prominent apophyses, sometimes, especially in male, distinct and with apophyses less developed; propodeum usually strongly rugose or transversely striate, rarely without sculpture, spiracles elongate; wings large; areolet small, complete, quadrangular, broadening toward apex, recurrent interstitial or somewhat antefurcal; nervulus antefurcal; second discoidal cell broad at base; nervellus broken near bottom and perpendicular or weakly reclivous; legs long and usually rather slender; front tibia in female rarely slightly inflated. Abdomen in female fusiform, in male small and narrow; spiracle of first segment far beyond middle; ovipositor sheath from a half to fully as long as abdomen; ovipositor subsagittate or swordlike at apex.

Head and thorax ornamented with white or yellow on a black or red ground; abdomen black and yellow or largely red; wings immaculate hyaline or dilutely infumate.

The color pattern of the head and thorax nearly throughout the genus is so similar as to constitute almost a generic character. In order to avoid much repetition a description of what may be called the normal or basic color pattern is given here. In the specific descriptions only variations from this pattern are indicated.

Ground color of head and thorax black, rarely red or partly red, with pale-yellow or whitish markings as follows: Orbital ring, broad on cheek, much narrower or interrupted on upper temple and in malar space; face, clypeus (apical margin always dark), labrum, mandible basally, palpi, annulus on antenna; propleura more or less; anterior and humeral margins of pronotum; mesoscutum either immaculate, or with a single spot on disk, or with paired lines along inner margins of lateral lobes, or with a narrow line on each lateral margin oppo-

site tegulae, or with cuneiform markings on anterior margins of lateral lobes, or with combination of two or more of these; scutellum, its subtending carinae, and posterior margin of its frenum; postscutellum and margin of its frenum; tegulae; subalar tubercles; an oblique band on mesopleuron from near anterior margin to middle coxa; a larger or smaller spot on each side of mesosternum; upper division of metapleuron and its lower division largely, the latter with the ground color showing only below; and two broad marks posteriorly on propodeum embracing the apophyses, very rarely confluent anteriorly. In the descriptions this color pattern is referred to as black (or red) with yellow or white markings and the exceptions noted.

The abdomen is either largely red or the ground color is black, typically with broad apical and lateral margins of tergites 1-7, lateral margins of tergite 8, and the petiole more or less yellow or whitish; venter white with sternites darker. In the following descriptions this color pattern is referred to merely as black, the tergites margined with yellow and the exceptions noted.

#### SPECIFIC CHARACTERS

For the most part *Cryptanura* is a very homogeneous group with few striking structural characters that will serve to divide it into specific groups, and it has been found necessary to depend to a considerable extent on color in the construction of the following key to species.

The form of the scutellum, the structure of the propodeum and pronotum, and the form of the ovipositor have been found useful as group characters, though the last, of necessity unisexual, does not appear to be accompanied by a companion character in the opposite sex.

A considerable number of the described species have not been available for study and have been omitted from the following key, but to assist in the identification of these species I have constructed a key to all the species, based largely on color. This will be found following the descriptions of the species examined.

#### KEY TO SPECIES EXAMINED

1. Scutellum strongly subconically elevated; metapleuron also with a tuberculate elevation..... 1. *tuberculata*, new species  
     Scutellum and metapleuron not strongly elevated..... 2
2. Apical carina of propodeum distinct medially at level of apophyses; abdomen polished and unsculptured..... 3  
     Apical carina usually absent, sometimes distinct in male, but then arching high above apophyses; abdomen usually distinctly, finely sculptured... 5
3. Abdomen and propodeum entirely red..... 2. *dicostata*, new species  
     Abdomen and propodeum black and yellow..... 4
4. Mesoscutum with yellow marginal markings, but without discal markings. 5  
     Mesoscutum with paired discal markings, but without marginal markings. 5. *bicarinata*, new species

5. Mesoscutal markings in form of narrow marginal lines opposite tegulae; tergite 2 yellow at apex, the yellow band broader medially; tegulae yellow basally----- 3. *quadrimaculata*, new species
- Mesoscutal markings in form of cuneiform spots laterad of origins of notaulices; tergite 2 with a uniformly broad subapical yellow band; tegulae entirely black----- 4. *mediostrigosa*, new species
6. Humeral margin of pronotum conically prominent anteriorly; scutellum broad and transversely flat, with coarse, deep punctures; abdomen polished, without trace of sculpture; front tibia in female subinflated; hind femur stout, not or barely two-thirds as long as tibia; pale markings of propodeum extending broadly forward to basal carina----- 7
- Disagreeing with all or nearly all above characters----- 10
7. Abdomen black and yellow (or white)----- 8
- Abdomen largely or entirely red----- 9
8. Legs red, coxae marked with yellow; thorax reddish piceous and yellow.  
6. *piceothorax*, new species
- Legs and thorax black and yellow----- 7. *planiscutellata*, new species
9. All coxae and front and middle femora black and yellow.  
8. *politigaster*, new species
- Hind coxae and all femora red----- 9. *conica*, new species
10. Epomia not extending upward to humeral margin of pronotum, the humeral margin not at all carinate or tuberculate anteriorly; ventrolateral carina of petiole distinct to base; second tergite with a median white spot at base----- 11
- Epomia forming a carinate elevation on humeral margin of pronotum; ventrolateral carina not distinct to base; second tergite without a median white spot----- 12
11. Head and thorax red and yellow; antenna without white annulus; abdomen polished----- 10. *ruficeps*, new species
- Head and thorax black and yellow; antenna with white annulus; abdomen beyond first tergite opaque shagreened, second and third tergites also punctate----- 11. *septentrionalis*, new species
12. Mesoscutum with two yellow marks discally----- 13
- Mesoscutum with a single median spot, rarely flanked by small traces of yellow on inner margins of lateral lobes----- 16
13. Petiole and hind femur entirely black----- 12. *apophysis*, new species
- Petiole and hind femur partly yellow----- 14
14. Propodeal yellow spots not abruptly narrowed before apophyses, the latter long----- 15
- Propodeal yellow spots abruptly narrowed before apophyses, the latter short----- 15. *bilineata*, new species
15. Petiole yellow above, black below; hind femur entirely black above.  
13. *mexicana* (Cresson)
- Petiole black above, yellow below; hind femur with a narrow median yellow line above----- 14. *orizabensis* (Cameron)
16. Thorax red and yellow----- 16. *rufa*, new species
- Thorax black and yellow----- 17
17. Propodeal spots each with a narrow forward extension, sometimes (male) confluent medially----- 18
- Propodeal spots either not extending forward or not abruptly narrowed before apophyses----- 22
18. Abdomen black and yellow----- 19
- Abdomen largely or entirely red----- 20



19. Front and middle femora red; hind femur red (♀) or entirely black (♂); hind coxa red (♀) or black (♂) with a yellow spot above.
17. *spinaria* (Brullé)  
All femora black and white, hind femur white below, black above, with a narrow median white line; hind coxa white below and above, black on each side.
20. Hind coxa black and white.
18. *lineatifemur*, new species  
Hind coxa largely or entirely red.
21. Humeral margins of pronotum prominent, subtuberculate anteriorly; postpetiole red.
20. *boliviensis*, new species  
Humeral margins of pronotum merely carinate anteriorly, not prominent; postpetiole piceous, margined with yellow.
21. *isthmus*, new species
22. Ovipositor nearly as long as abdomen, stout, much deeper toward apex than at base, not sagittate at apex.
- 23  
Ovipositor slender, its upper and lower margins parallel except at the sagittate apex, usually much shorter than abdomen.
- 25
23. Abdomen red.
22. *excalibur*, new species  
Abdomen black and white.
- 24
24. Hind coxa largely and femur red.
23. *acinaces*, new species  
Hind coxa yellow and black; femur black or piceous above, yellowish below.
24. *propinqua* (Cresson)
25. Front and middle femora entirely red.
25. *pretiosa* (Viereck)  
Front and middle femora piceous posteriorly.
- 26
26. Hind leg very slender, femur apparently nearly 8 times as long as deep; temples in dorsal view very strongly receding and slightly concave.
26. *gracilipes*, new species  
Hind leg stouter, femur apparently not more than 6 times as long as deep; temples flat or weakly convex or concave.
- 27
27. Temple at middle of eye distinctly more than half as broad as short diameter of eye and very weakly convex.
- 28  
Temple not or barely half as broad as short diameter of eye and flat or weakly concave.
- 29
28. Head in side view with occipital carina very nearly parallel to posterior margin of eye; apical margin of clypeus weakly curved.
27. *gracilis*, new species  
Occipital carina and posterior margin of eye distinctly divergent below; apical margin of clypeus perfectly straight.
28. *genalis*, new species
29. Hind femur rather slender, at least 6 times as long as deep and more than three-fourths as long as tibia; flagellum in female much thickened beyond middle and flattened below, the joints there strongly transverse.
- 30  
Hind femur rather stout, distinctly less than 6 times as long as deep and less than three-fourths as long as tibia; flagellum in female only slightly thickened and flattened beyond middle, the joints there weakly transverse.
- 32
30. Occipital carina nearly parallel to posterior margin of eye; ovipositor sheath hardly as long as abdomen beyond first tergite.
29. *variegata* (Brullé)  
Occipital carina and posterior margin of eye distinctly divergent below; ovipositor sheath nearly as long as abdomen.
- 31
31. Temple at middle of eye distinctly less than half as broad as short diameter of eye; flagellum very slender at base, first joint more than 6 times as long as thick at middle.
30. *paranensis*, new species  
Temple about half as broad as short diameter of eye; flagellum stouter, first joint not 6 times as long as thick at middle.
31. *tenuiterebrata*, new species

32. Face entirely yellow; front and middle coxae piceous behind, yellow in front, metathorax not at all red..... 32. *incerta* (Cresson)  
 Face with longitudinal impressions broadly black; front coxa largely piceous, middle coxa entirely red; metapleuron below and metasternum red..... 33. *maculifrons*, new species

1. *CRYPTANURA TUBERCULATA*, new species

Evidently closely allied to *scutellaris* (Szépligeti) and possibly synonymous with that species. However, it seems unlikely that Szépligeti would have failed to mention the very evident tuberculiform metapleura characteristic of the present species if his species were of similar structure.

*Female*.—Length 19 mm., antenna 17 mm., ovipositor sheath 8 mm.

Head in dorsal view with temples very slightly concave, occipital carina flangelike, sinuate at lower extremity; frontal horns very small; scrobes very deep; a distinct, radiately rugose impression surrounding the ocelli except behind; postocellar line hardly as long as ocellocular line, stemmaticum longitudinally rugose; eyes parallel within, faintly sinuate opposite frons; face with a median subhemispherical elevation flanked on each side by a transversely rugose impression; clypeus smooth, with scattered punctures, roundly convex with a broad reflexed margin, broadly truncate; malar space very nearly as long as basal width of mandible; antenna only slightly thickened beyond middle, 38-jointed. Thorax polished, with notaulices, margins of mesoscutum, sternaules, and groove along posterior margin of mesopleuron foveolate; scrobe of pronotum, upper anterior portion of mesopleuron, metapleuron, and sides of propodeum obliquely striate; mesopleuron below and sternum sparsely punctate; humeral margin of pronotum smooth, anteriorly tuberculate; scutellum very strongly elevated, subconical, in profile with its posterior slope deeply concave; metapleuron with a high rounded tubercle in the middle; legs very long and slender, hind femur reaching distinctly beyond apex of abdomen and fully eight times as long as deep; coxae polished and sparsely punctate. Abdomen almost exactly as long as head and thorax, rather narrow, very finely shagreened, subopaque beyond first tergite; petiole distinctly depressed; ovipositor rather stout, becoming gradually slightly deeper toward apex, where it is swordlike rather than subsagittate.

Head and thorax black with yellow maculation (see description of color pattern, p. 141), abdomen ferruginous, legs ferruginous and partly yellow and piceous; wings subhyaline, with blackish venation; orbital ring interrupted on upper temples and in malar space; facial impressions and outline of clypeus black; annulus on antenna embracing flagellar joints (5)6–12(13); two yellow lines on disk of mesoscutum; apex and anterior face of the elevated part of scutellum black; sternum yellow only along sternaules; lower division of metapleuron

with only the tubercle and its apex yellow; stripes on propodeum extending only a short distance basad of apophyses. Front coxa behind and all femora behind piceous, this color reduced on hind femur to a narrow stripe on the inner side and the apex; front legs otherwise yellowish, as are also the middle coxa, tibia, and tarsus, the hind tibia except at apex, and a stripe on inner side, which are blackish, and the hind tarsus. Ovipositor sheath black.

*Type locality*.—St. Laurent du Maroni, French Guiana.

*Types*.—A holotype and a paratype, both females, taken at the above locality by Audoit in 1862. The type is in the Paris Museum<sup>1</sup> and the paratype in the U. S. National Museum (No. 57080).

The paratype is a little larger than the type but is otherwise like it.

## 2. CRYPTANURA DICOSTATA, new species

Apparently related to *similis* (Szépligeti) and perhaps the same but having the apical carina of the propodeum more or less distinctly developed, a character not mentioned by Szépligeti.

*Female*.—Length 12 mm., antennae 11 mm., ovipositor sheath 4 mm.

Temples very narrow and strongly receding, flat; occipital carina neither especially prominent nor sinuate at lower extremity; vertex and frons deeply concave, ocelli distinctly below level of superior tangent of eyes, frontal horns small; face nearly flat, transversely rugulose and very minutely shagreened, subopaque; clypeus strongly convex, with very narrow reflexed margin, polished, with sparse punctures; malar space about two-thirds as long as basal width of mandible, finely opaque; head elsewhere polished; postocellar line and diameter of an ocellus about equal and much shorter than ocellular line; antenna 33-jointed, slender, only slightly thickened and flattened beyond middle. Thorax anteriorly subopaquely sculptured, posteriorly polished and almost without sculpture; humeral margin of pronotum smooth, anteriorly angulate, scrobe striate; mesoscutum punctate, prescutum transversely striate on each side next to the notaulices, lobes flattened; scutellum convex, polished, with a few punctures; mesopleuron striatopunctate above, punctate below, smooth posteriorly; sternum punctate; metapleuron polished and sparsely punctate, with a few rugae posteriorly; propodeum smooth and polished, more or less roughened medially between carinae; apical carina distinct and straight between apophyses; basal carina only slightly curved medially; basal area not at all defined; legs long, hind femur about six times as long as deep and reaching slightly beyond apex of abdomen; coxae polished. Abdomen distinctly longer than head and thorax, polished, unsculptured, rather slender; first segment without trace of dorsal carinae, petiole slightly broader than deep,

<sup>1</sup> All specimens indicated as being in, or received from, the Paris Museum are retained in the U. S. National Museum for the duration of the war.

postpetiole barely as wide as long; second tergite as long as first and about twice as long as broad at base; ivopositor sheath shorter than abdomen beyond first segment; ovipositor slender, of even depth throughout, apex weakly subsagittate.

Head and anterior portion of thorax black with yellow markings (see description of color pattern, p. 141); thorax posteriorly, mesosternum, abdomen, and legs ferruginous; antennal annulus embracing flagellar joints (4) 5-11 (12), two narrow yellow streaks on disk of mesoscutum, scutellum yellow only in basal angles and at apex, mesopleuron yellow except the prepectus, the impression below tubercle, and an oblique streak running down from this, which are black; upper division of metapleuron yellow tinged with ferruginous; propodeum, lower section of metapleuron, and sternum, except prepectus, ferruginous; front coxae anteriorly and all tibiae and tarsi yellow; front and middle femora piceous below and behind; wings yellowish hyaline, venation dark brown; abdomen entirely ferruginous, sheath black.

*Type locality*.—Kamakusa, British Guiana.

*Types*.—Four females, the holotype and three paratypes in the U. S. National Museum (No. 57058).

The type and two paratypes were taken at the type locality by H. Lang. The third paratype is from Port-of-Spain, Trinidad.

One specimen of what is probably the male of this species was taken by W. M. Mann at Cavinass, Beni, Bolivia, during the Mulford Biological Exploration of 1921-22. It has the mesopleuron and sternum almost entirely yellowish stramineous, the antennal annulus embracing flagellar joints (5) 6-19 (20), and the apical carina of propodeum only faintly indicated medially. It is excluded from the type series.

### 3. CRYPTANURA QUADRICACULATA, new species

Apparently closely allied to *ectypa* (Cresson), from the description of which it differs in its possession of yellow lateral lines on the mesoscutum. Also Cresson makes no mention of the presence, in his species, of the apical carina of the propodeum.

*Female*.—Length 13 mm., antennae (broken), ovipositor sheath 4.5 mm.

Temples flat, short and very sharply receding, occipital carina moderately prominent, bent abruptly inward at its lower extremity to meet the hypostomal carina far back from base of mandible; vertex and frons concave, lateral ocelli slightly below superior tangent of eyes, frontal horns very acute and arising from common base; postocellar line and diameter of an ocellus equal and distinctly shorter than ocellular line; eyes large and bulging, weakly convergent below; face and clypeus minutely shagreened, subopaque, face laterally and clypeus

sparsely punctate, face dorsally irregularly striate; clypeus strongly convex, in profile subnasute; malar space hardly two-thirds as long as basal width of mandible. Thorax rather slender, generally polished; pronotum striate in lower part of scrobe, its upper anterior margin only weakly tumid, smooth, carinately angled; mesoscutum sparsely punctate, rugose in posterior middle, prescutum more densely punctate and transversely striate anteriorly along notaulices, lobes flattened; mesopleuron largely and sternum sparsely punctate, space below tubercle more or less striate; scutellum convex, with scattered punctures; metapleuron very sparsely punctate and with a few vertical striae posteriorly; propodeum with sparse, coarse punctures basally and more or less distinctly longitudinally striate medially behind basal carina, basal area obsoletely defined, basal carina bent sharply forward medially, apical carina distinct between apophyses; legs slender but hind femur less than two-thirds as long as tibia and not reaching apex of abdomen; coxae elongate, polished, and sparsely punctate, areolet narrow. Abdomen longer than head and thorax, polished, with scattered punctures on basal tergites; first tergite narrow, petiole not depressed, dorsal carinae absent, postpetiole barely as broad as long, with a median impression between spiracles; second tergite as long as first and nearly twice as long as broad at base; sheath nearly as long as abdomen beyond first tergite; ovipositor slender, of nearly uniform depth, and subsagittate at apex.

Black and yellow (see description of color pattern, p. 141); cheeks, frontal orbits, an annulus beginning on flagellar joint 6 (missing beyond joint 8) yellow; anterior margin of pronotum black except for a small spot; humeral margin entirely black; narrow lines on lateral margins of mesoscutum above tegulae, only basal angles and apex of scutellum, tegulae basally, and mesopleuron except prepectus largely yellow, the last confluent with mark on sternum, metapleuron except suture between upper and lower divisions and a dash near apex entirely yellow, large yellow spots in basal lateral areas of propodeum, apical markings of propodeum with triangular projection anteriorly, apical bands on basal tergites triangularly broadened medially; petiole yellow above, black below; venter yellow. Legs yellow, with front and middle coxae behind, hind coxa within and medially above, middle trochanter and femur behind, hind trochanter largely, and femur except a yellow streak on each side black or piceous; wings hyaline, venation blackish.

*Male*.—Essentially like female, the frontal horns much longer.

*Type locality*.—San Bernardino, Paraguay.

*Types*.—A female holotype, an allotype, and a female paratype in the U. S. National Museum (No. 57059). All were collected at the above locality by K. Fiebrig.

The paratype female is essentially like the type.

4. CRYPTANURA MEDIOSTRIGOSA, new species

*Female*.—Length 14 mm., antenna 12 mm., ovipositor sheath 4.5 mm.

Differs from the above description of *quadrимaculata* principally as follows: Mesopleuron polished, with a small area of rather coarse punctures anteriorly; metapleuron rather coarsely punctate-rugose over most of its surface; propodeum polished basally, longitudinally striate medially between the transverse carinae and in petiolar area; hind femur fully two-thirds as long as tibia and fully reaching apex of abdomen; abdomen polished and entirely without sculpture; petiole depressed; postpetiole fully as broad as long, flat between spiracles.

Color pattern as in *quadrимaculata* except frontal orbit broader and extending over top of eye; antennal annulus beginning on joint 5; anterior margin of pronotum entirely black, humeral margin with a white mark at the angle; mesoscutum with cuneiform markings extending backward from origins of notaulices; tegulae entirely black; mesopleuron and sternum and metapleuron and sternum stramineous rather than yellow, this color including also most of the prepectus; propodeum dorsally yellow except for a cruciform black mark with its crossbar on the basal carina; yellow bands of abdomen subapical and of nearly uniform width; front and middle legs yellow, with femora posteriorly and apical half or more of tarsi blackish; hind leg stramineous, trochanter and femur black above.

*Male*.—Essentially like female.

*Type locality*.—Barro Colorado Island, Canal Zone.

*Types*.—Two females collected at the type locality by S. W. Frost, the holotype on March 10, the paratype on March 22, 1937; and one male allotype taken by A. Busck on March 12, 1912, at Alhajuela, Canal Zone. All are in the U. S. National Museum (No. 57060).

5. CRYPTANURA BICARINATA, new species

Though related to *quadrимaculata* in its possession of the distinct apical carina and in its highly polished abdomen, this species is very distinct, especially in the minute frontal horns, stouter body, and different arrangement of color. It seems unlikely that this can be *championi* (Cameron), also from Panama, for it is apparently much stouter and has the black on the inner side of the hind femur rather than on the upper side. Moreover, Cameron does not mention the presence in his species of the apical carina of the propodeum.

*Female*.—Length 13 mm., antennae 12 mm., ovipositor sheath 5.5 mm.

Temples flat, narrow, sharply receding, occipital carina rather prominent, its lower extremity curving slightly to join the hypostomal carina back from the base of the mandible; vertex and frons con-

cave, ocelli slightly below superior tangent of the eyes; frontal horns obsolete, their common base distinct; eyes large, bulging, very faintly convergent below; face rather flat, with a transversely striate impression on each side of middle, the upper striae extending across middle, laterally opaque shagreened, medially polished; clypeus polished and sparsely punctate, in profile strongly convex; malar space hardly two-thirds basal width of mandible; antennae 32-jointed, only very slightly thickened, and flattened beyond middle. Thorax rather stout, polished and sparsely punctate except as noted below; humeral margin of pronotum smooth, carinately angled anteriorly, scrobe striate below; lobes of mesoscutum rather flat, prescutum transversely striate along notaulices; scutellum weakly convex; mesopleuron anteriorly and metapleuron in lower posterior angle obliquely striate; propodeum with basal area defined, basal carina arching forward medially, apical carina distinct between the very stout, compressed apophyses, middle of propodeum both before and behind apical carina obsoletely transversely rugose, and with a few coarse rugae radiating from the apical margin; legs rather stout, hind femur hardly five times as long as thick, less than two-thirds as long as tibia and barely reaching apex of abdomen; areolet rather broad, its lower side distinctly angled by the strongly antefurcal recurrent. Abdomen polished, stout, petiole distinctly depressed, postpetiole broader than long, dorsal carinae absent; second tergite shorter than first and barely a half longer than broad at base; ovipositor sheath about as long as abdomen beyond first tergite, ovipositor rather slender, of uniform depth, and weakly subsagittate at apex.

Black and yellow (see description of color pattern, p. 141); orbital rings of unusually uniform width behind eyes; annulus embracing flagellar joints (5) 6-10 (12); yellow of anterior margin of pronotum reduced to two small spots near middle; two small streaks on disk of mesoscutum; scutellum with an elongate black mark in basal middle; mesopleuron entirely yellow; yellow spots in basal lateral areas of propodeum and the apical bands extending forward nearly to basal carina; petiole yellow both above and below; broad subapical bands and lateral margins of tergites 2 and 3 yellow, the color extending inward at base of second; remaining tergites entirely and venter yellow. Front and middle legs yellow, with femora and middle trochanters piceous posteriorly; middle coxa piceous on each side above; hind coxa similarly marked but more reddish beneath; trochanter stained with piceous; femur reddish on outer side, piceous within; tibia and tarsus yellow. Wings hyaline, venation black.

*Type locality*.—Trinidad Río, Panama.

*Type*.—One specimen taken by August Busck, March 16, 1912. It is in the U. S. National Museum (No. 57061).

6. CRYPTANURA PICEOTHORAX, new species

*Female*.—Length 12 mm., antennae 8.5 mm., ovipositor sheath 3.5 mm.

Temples narrow, flat, and sharply receding; occipital carina prominent, especially below, where it joins the hypostomal carina not far from the base of the mandible; vertex nearly straight across except for a groove at each side of ocelli; ocelli at level of superior tangent of eyes; frons moderately concave, slightly tumid laterally, horns prominent on a common base; eyes moderately large and somewhat bulging, weakly convergent below; face with a rather deep striate impression on each side of middle, the middle roundly convex and with sparse, coarse punctures; clypeus sculptured like middle of face, strongly convex, in profile subnasute; malar space flat, nearly as long as basal width of mandible; antennae stout, slightly thickened and flattened near apex, 29-jointed. Thorax stout, generally coarsely punctate to striatorugose; pronotum with humeral margin smooth, conically produced anteriorly, scrobes coarsely striate; mesoscutum coarsely punctate, prescutum somewhat rugose, lobes rather flat; scutellum flat and coarsely punctate above, apex rather abrupt and impunctate; frena of both scutellum and postscutellum coarsely foveolate; pleura and propodeum coarsely striatorugose; sternum coarsely punctate; basal areas partly smooth; basal median area partly defined, basal carina nearly straight; legs rather stout, hind femur little more than two-thirds as long as tibia and not extending to apex of abdomen; hind coxa coarsely punctate above; areolet short. Abdomen broad, polished; petiole strongly depressed, postpetiole much broader than long, with a weak elevation on each side of middle between spiracles, but without dorsal carinae; second tergite a little shorter than first and only about a third longer than broad at base; sheath shorter than abdomen beyond first tergite; ovipositor rather thick, in profile rather slender, a little deeper near apex, the apex not at all sagittate.

Head and thorax black to reddish piceous, both with yellow markings (see description of color pattern, p. 141); annulus embracing flagellar joints (5) 6-9 (10); single spot on disk of mesoscutum; only apex of scutellum yellow; most of mesopleuron and sternum and metapleuron except suture separating its two divisions yellow; propodeal marking extending broadly forward to basal carina, but constricted before apophyses. Legs ferruginous, coxae and trochanters partly yellow. Wings hyaline, veins black, stigma brown. Abdomen black with white markings; petiole, except ventrally, white; three spots transversely arranged at base of second tergite and a broad subapical band also white; the extreme apex black.



*Type locality*.—Baraguá, Camagüey, Cuba.

*Types*.—Two females, the holotype taken at light June 4, 1932 (Christenson), the paratype at Sole, Cuba, March 2, 1925 (George Salt). Both are in the U. S. National Museum (No. 57063).

The paratype is smaller, with the sculpture less heavy and the dark color of the thorax more reddish.

#### 7. *CRYPTANURA PLANISCUTELLATA*, new species

Very similar in form, structure, and color pattern to *piceothorax* but at once distinguishable by the color of its thorax, which is not at all red, and of the legs, which are black and yellow. Differs further from *piceothorax* as follows:

*Female*.—Length 12 mm., antennae 8.5 mm., ovipositor sheath 3.5 mm.

Sculpture of thorax, especially metapleuron and propodeum, including the basal areas, more reticulate-rugose than striatorugose; scutellum less abruptly sloping at apex; postpetiole and tergites 2 and 3 coarsely, sparsely punctate, especially laterally.

Antennal annulus longer, extending to flagellar joint 13; pale markings of abdomen yellow rather than white; legs to apices of femora black and yellow, tibiae and tarsi pale stramineous; front and middle coxae yellow, black behind, hind coxa yellow with base below and streaks on upper and inner sides black; trochanter yellow, basal joint above and apical joint at apex more or less black, hind trochanter with basal joint largely black; front and middle femora yellow, black behind; hind femur yellow on outer and inner sides, black above and below.

*Type locality*.—Puerto Castilla, Honduras.

*Type*.—One female dated March 26, 1924. It is in the U. S. National Museum (No. 57062).

This may be the same as *compacta* (Cresson).

#### 8. *CRYPTANURA POLITIGASTER*, new species

This species is similar in structure and in color pattern of head and thorax to the preceding two species but differs from both in its red abdomen and in other details.

*Female*.—Length 11 mm., antennae 9 mm., ovipositor sheath 3 mm.

Temples rather long, slightly but distinctly concave, sharply receding, occipital carina high, especially at lower extremity, where it passes over a prominence in the posterior margin of the cheek, and joins the hypostomal carina rather close to the base of the mandible; cheek transversely striate along carina, vertex flat with a shallow groove next to ocelli; frons deeply concave, tumid next to eyes, obliquely striate above, horns small but elevated on a high common base;

eyes large, somewhat bulging, weakly convergent below; face nearly smooth laterally and medially with a rugose impression on each side of middle, the rugae extending across middle at top; clypeus smooth with large scattered punctures, nasute in profile; malar space flat and fully as long as basal width of mandible; antenna rather stout, weakly thickened and flattened near apex, 30-jointed. Thorax stout; humeral margin of pronotum smooth, conically prominent anteriorly, scrobe striate; mesoscutum coarsely punctate, lobes rather flat, prescutum very low anteriorly; scutellum sloping from base to apex, polished, with a few large punctures; frena coarsely foveolate; mesopleuron longitudinally striate below tubercle, obliquely and indistinctly so below, elsewhere polished and sparsely punctate, prepectus rugulose-punctate, sternum polished and sparsely punctate; metapleuron coarsely rugose above, polished and punctate below, as is also its upper division; propodeum largely rugose, more or less transversely so behind apophyses, basal median area defined, basal carina curved medially; legs rather slender but not long, hind femur barely two-thirds as long as tibia and not reaching apex of abdomen; areolet short. Abdomen broad, polished, with a few large punctures at sides of postpetiole and second tergite; first segment stout, petiole flattened above but not distinctly depressed, postpetiole much broader than long, without trace of dorsal carinae; second tergite nearly as long as first, but barely a third longer than broad at base; ovipositor sheath distinctly shorter than abdomen beyond first segment; ovipositor of uniform depth; apex weakly subsagittate.

Head and thorax black with yellow markings (see description of color pattern, p. 141); annulus embracing flagellar joints (5) 6-11 (13); anterior margin of pronotum medially and humeral margins before tegulae black; spot in center of mesoscutum; scutellum yellow only at apex; mesopleural band divided into a large spot anteriorly and a smaller one posteriorly; a large spot on each side of sternum; both upper and lower divisions of metapleuron largely yellow; propodeal markings extending broadly forward to carina but constricted before apophyses. Front and middle legs yellow, with their coxae, trochanters, and femora black behind; hind coxa black and yellow, trochanter and femur ferruginous, tibia and tarsus yellow. Wings hyaline, venation black. Abdomen ferruginous; petiole and apex of first tergite yellow, postpetiole ferruginous and black; sternites pale ferruginous margined with whitish.

*Type locality*.—Rurrenabaque, Río Beni, Bolivia.

*Type*.—One female, taken in October by W. M. Mann on the Mulford Biological Exploration of 1921-22. It is in the U. S. National Museum (No. 57065).

9. *CRYPTANURA CONICA*, new species

Similar to *politigaster* but distinguishable at once by its much more strongly flexed occipital carina and by its entirely red femora and hind coxae.

*Female*.—Length 12 mm., antennae (tips broken off), ovipositor sheath 3.5 mm.

Temples rather long, slightly concave, and sharply receding; occipital carina high, especially below, where it passes over a strong angulation in the posterior margin of the cheek; vertex concave, ocelli distinctly below superior tangent of eyes; frons moderately concave, with rugae radiating from ocelli, horns small but elevated on a broad common base; eyes bulging, very weakly convergent below; face with a shallow impression on each side of middle, medially coarsely rugose, laterally smooth; clypeus with scattered coarse punctures, in profile subnasute; malar space fully as long as basal width of mandible, flat; antennae distinctly thickened and flattened beyond middle. Thorax stout, largely coarsely sculptured; pronotum with humeral margin transversely striate, conically produced anteriorly, scrobe coarsely striate; mesoscutum coarsely but not densely punctate, lobes, especially prescutum anteriorly, flattened; mesopleuron striate, the sculpture changing to punctation toward lower posterior angle. sternum polished and sparsely punctate; scutellum roundly sloping from base to apex, polished, with sparse punctures, frena foveolate; metapleuron obliquely punctatostriate, its upper division smooth and sparsely punctate; propodeum polished before carina, coarsely rugose behind, the rugosity becoming transverse on apical slope, basal median area defined, basal carina curved forward medially; legs rather slender but not very long, hind femur barely two-thirds as long as tibia and not reaching apex of abdomen, hind coxa polished, with sparse punctures; areolet narrow. Abdomen rather narrow, polished; petiole flat above but not depressed, postpetiole much broader than long, with no trace of dorsal carinae; second tergite about as long as first and about a half longer than wide at base; sheath much shorter than abdomen beyond first tergite; ovipositor slender, of uniform depth, and subsagittate at apex.

Head and thorax black with yellow markings (see description of color pattern, p. 141); orbital ring broadly interrupted on temples; annulus on flagellar joints (5)6-10(13); anterior margins of pronotum entirely and humeral margin posteriorly black; mesoscutum immaculate; apex of tegulae piceous; mesosternum immaculate; yellow marking of lower division of metapleuron reduced to a streak in the dorsoposterior half; propodeal markings extending from apex to basal carina and narrowing and divergent from apophyses to carina. Legs ferruginous, tibiae and tarsi and front and middle coxae ante-

riorly yellow. Wings hyaline, venation black. Abdomen ferruginous, petiole and apex of postpetiole stramineous.

*Type locality*.—Kamakusa, British Guiana.

*Type*.—One female taken by H. Lang. It is in the U. S. National Museum (No. 57066).

10. CRYPTANURA RUFICEPS, new species

This and the next following species differ from all others known to me in lacking any trace of angulation of the tumid humeral margin of the pronotum; and the present species is unique in the genus for its red head and is very unusual in its lack of a pale annulus on the antenna.

*Female*.—Length 13 mm., antennae 10.5 mm., ovipositor sheath 4.5 mm.

Temples short, distinctly convex, sharply sloping, occipital carina rather high, especially at lower end, hypostomal carina very high; vertex straight across, ocelli elevated above general level; frons not deeply excavated, horns very small, on a broad, low, common base; eyes not bulging; parallel within; face subpolished, with coarse punctures, especially in shallow impressions on each side of middle, median portion in profile nearly as strongly convex below as is clypeus, which is not so strongly convex as usual and is sculptured like the face; malar space a little shorter than basal width of mandible; cheeks in front view slightly convex, in side view fully twice as broad as malar space; antenna slightly thickened and flattened beyond middle. Thorax robust, sculpture mostly coarse rugosity; pronotum with scrobe coarsely striate, epomia strong, but terminating below the smooth humeral margin, which is less strongly tumid anteriorly than posteriorly; mesoscutum with lobes very weakly convex and notaulices very shallow, polished and sparsely, coarsely punctate; scutellum strongly convex but not prominently so, polished, with a few punctures, frena foveolate; mesopleuron largely coarsely rugosostriate; sternum coarsely punctate; metapleuron and propodeum, except its punctate basal areas, transversely striate, basal median area not defined, basal carina curved forward medially; apophyses unusually short and obtuse; legs rather slender, hind femur three-fourths as long as tibia and reaching apex of abdomen, hind coxa polished and punctate; areolet broad. Abdomen stout, polished; petiole distinctly depressed, ventrolateral carina strong, with a foveolate groove above it, postpetiole much broader than long, with low rounded elevations representing the dorsal carinae; second tergite about a fourth longer than broad at base; ovipositor sheath not quite so long as abdomen beyond first tergite, ovipositor rather stout, subsagittate at apex.

Head and thorax rufous with yellow markings (see description of color pattern, p. 141); orbital ring not abruptly narrowed on temples; facial impressions, clypeal suture, and margin of clypeus ferruginous; scape rufous, flagellum entirely black; mesoscutum with a single median spot; scutellum with a rufous spot in basal middle; mesosternum and both upper and lower divisions of metapleuron largely rufous; propodeal markings each with a narrow tongue-shaped extension before the apophyses and reaching nearly to basal carina. Antenna black, scape rufous, without white annulus; small areas in rufous coloring of head and thorax more or less piceous; legs entirely ferruginous; wings yellowish hyaline, venation black. Abdomen black and white; three white spots at base of second tergite, the middle one large and broadly transverse, the lateral ones small and longitudinal; venter mostly white; sheath black.

*Type locality*.—Pico Turquino, Cuba.

*Types*.—A holotype and four paratypes, all females, collected by S. C. Bruner and C. H. Ballou, July 10–20, 1922, at elevations ranging from 2,900 to 6,000 feet. They are in the U. S. National Museum (No. 57067).

#### 11. *CRYPTANURA SEPTENTRIONALIS*, new species

Related to *ruficeps* in the lack of the angulation of the humeral margins of the pronotum and in the color pattern of the abdomen, but distinct from that species in the black and white head and thorax and in many details of structure and color.

*Female*.—Length 15 mm., antennae (broken), ovipositor sheath 4.5 mm.

Differs from *ruficeps* principally as follows: Frons obliquely striate above, horns not on a common base; postvertex densely, temples, cheeks, and sides of frons more sparsely, punctate; face rugose except laterally, less strongly convex medially; malar space much shorter than basal width of mandible; occipital and hypostomal carinae weaker; sculpture of thorax largely coarse punctation, densest and coarsest on mesoscutum and metapleuron, humeral margin of pronotum coarsely punctate; propodeum posteriorly irregularly transversely rugose, scutellum polished; notaulices deep; apophyses longer; abdomen beyond first tergite opaque shagreened, second and third tergites and postpetiole at sides punctate; ventrolateral carinae of petiole subobsolete.

Differs from *ruficeps* in color as follows: Head and thorax black and white; face entirely white; antennal annulus embracing flagellar joints (5) 6–11 (12) and underside of scape white; propodeal white marks narrowly confluent across median line anteriorly; coxae white, the front and middle ones more or less black behind, the hind coxa black on outer and inner sides toward base and with a median black stripe above, trochanters largely white, legs otherwise ferruginous, with tarsi paler,

*Type locality*.—Cleveland, Ohio.

*Types*.—One female (the holotype) captured September 19, 1932, by Frank D. DeGant; one female paratype, St. Louis, Mo., June 29, 1938; and one female paratype received from H. A. Scullen, Corvallis, Oreg., but probably eastern. All are in the U. S. National Museum (No. 57068).

This is the second species of this tropical genus to be found in the United States.

12. *CRYPTANURA APOPHYSIS*, new species

Distinct from all the other species known to me in its extraordinarily large propodeal apophyses. It is also almost unique in its entirely yellow front and middle legs and black hind femur.

*Female*.—Length 15 mm., antennae (missing), ovipositor sheath 5.5 mm.

Temples flat to slightly concave, long, sharply receding; occipital carina very high, but becoming abruptly lower just before its junction with the very high hypostomal carina; vertex concave, top of ocelli below superior tangent of eyes; frons with short rugae radiating from ocelli, deeply concave below, horns short, stout, not on a common base; eyes very large, bulging, very weakly convergent below; face medially elevated, with an impression on each side of middle. opaque shagreened, with sparse punctures, obliquely rugose below antennae; clypeus subnasute, subpolished, with a few coarse punctures; malar space nearly as long as basal width of mandible, straight in front view. Thorax distinctly compressed; pronotum with humeral margin transversely striate, carinately angulated anteriorly, scrobe striate; mesoscutum subpolished and rather densely and coarsely punctate, lobes low, notaulices deep and narrow; scutellum strongly convex, polished, very sparsely punctate; mesopleuron subpolished, sparsely punctate below, scrobe polished below and striate above; mesosternum more densely punctate; upper division of metapleuron coarsely punctate, lower division coarsely obliquely rugosostriate; propodeum rugose laterally and between carina and apophyses, otherwise largely polished, apophyses very large, long, conical, nearly twice as long as their distance from basal carina; legs very slender, hind femur fully eight times as long as deep and reaching beyond apex of abdomen; areolet elongate. Abdomen slender, finely shagreened and subopaque beyond first tergite; petiole almost exactly square in cross-section, postpetiole nearly as long as broad; second tergite fully two-thirds longer than broad at base; sheath as long as abdomen beyond first tergite; ovipositor rather stout, distinctly subsagittate at apex.

Black and yellow (see description of color pattern, p. 141); orbital ring nearly interrupted in upper temple and in malar space; two

narrow lines on disk of mesoscutum; a large spot anteriorly on mesopleuron and a smaller one before middle coxa; yellow of lower division of metapleuron reduced to a large spot in the middle of its upper margin; propodeal spots extending only a short distance anterior to apophyses; front and middle legs except their coxae at base behind, a large spot on upper side of hind coxa, hind tibia except narrowly at base and broadly at apex, and probably hind tarsi (though these are missing) yellow; petiole entirely black; wings yellowish hyaline, venation blackish.

*Male*.—Essentially like female, but more highly polished; the propodeum with striae radiating from bases of apophyses, which are somewhat more slender than in female; postpetiole fully as long as broad and second tergite fully twice as long as broad at their junction; legs even more slender.

The antennae, though not entire, exhibit a yellow annulus beginning on the eleventh flagellar joint, and the hind tarsus is entirely yellow.

*Type locality*.—Colombia.

*Allotype locality*.—Huascarán, Peru.

*Types*.—One of each sex, the type female, having no further data; the allotype taken September 21, 1911, by C. H. T. Townsend. Both are in the U. S. National Museum (No. 57069).

### 13. CRYPTANURA MEXICANA (Cresson), new combination

*Mesostenus mexicanus* CRESSON, Proc. Acad. Nat. Sci. Philadelphia, 1873, p. 157, female, male (part).

Cresson's type series was not all of the same species, for a male cotype in the National Collection is referable to *orizabensis* (Cameron). A female cotype agrees with Cresson's description, and apparently is the true *mexicana*.

Three additional specimens are before me as follows: Argas, Panama, April 28, 1911 (A. Busck); Costa Rica and Santa Marta, Colombia, 1852 (Fontanier), the last belonging to the Paris Museum.

*Female*.—Length 14 mm., antennae 14 mm., sheath 5.5 mm.

Temples flat or slightly concave, occipital carina high, slightly sinuate below; vertex weakly concave, ocelli a little below superior tangent of eyes; postocellar line much shorter than ocellocular line; frons moderately concave, with a few rugae radiating from the ocelli, horns short and broad, not on a common base; eyes large, bulging, weakly convergent below; face convexly elevated medially, polished and sparsely punctate, with a transversely striate impression on each side of middle; clypeus strongly convex but not subnasute, polished and sparsely punctate; malar space nearly as long as basal width of mandible, in front view straight; antenna about 38-jointed, strongly thickened and flattened below beyond middle. Thorax stout; humeral margin of pronotum transversely striate, carinately

angled anteriorly, scrobe striate; mesoscutum polished, sparsely coarsely punctate, notaulices deep and narrow; scutellum narrow, convex, polished, with a few punctures; mesopleuron obliquely striate above, the striation changing gradually to punctation below, sternum punctate; upper division of metapleuron punctate, lower division coarsely, obliquely rugosostriate; propodeum with basal median area obsoletely defined, basal carina curving forward medially, apophyses long and slender; basal areas punctate and posteriorly more or less rugose, space between carina and apophyses with oblique striae converging toward middle, posterior face more coarsely, transversely striate; legs long and slender, hind femur reaching apex of abdomen, hind coxa sparsely, coarsely punctate; areolet elongate. Abdomen beyond first tergite finely shagreened, subopaque; petiole not depressed, postpetiole broader than long, with median and lateral shallow impressions; sheath a little longer than abdomen beyond first tergite; second tergite about a half longer than broad at base; ovipositor subsagittate at apex.

Black with yellow markings (see description of color pattern, p. 141); orbital ring interrupted in upper temples; annulus embracing flagellar joints (5) 6-10 (12); two elongate marks on disk of mesoscutum; scutellum yellow only at apex, mesosternum largely yellow; lower division of metapleuron very largely yellow; propodeal markings extending forward nearly to carina; petiole yellow above, black below. Legs yellow; front and middle coxae and femora behind, base of hind coxa and a broad stripe above, and apical joint of hind trochanter and the femur above black. Wings hyaline, narrowly, weakly infumate apically, venation blackish.

I have not seen a male of this species, but according to Cresson it differs from the female in being more slender, with antennae and legs longer, the knees and the apex of the hind tibia black.

14. *CRYPTANURA ORIZABENSIS* (Cameron), new combination

*Mesostenus mexicanus* CRESSON, Proc. Acad. Nat. Sci. Philadelphia, 1873, p. 157, male (part).

*Polygenus orizabensis* CAMERON, Biologia Centrali-Americana, Hymenoptera, vol. 1, 1886, p. 246, female.

As stated above, the National Museum male cotype of *mexicana* (Cresson) belongs to this species. A female, also from Mexico, from the C. F. Baker collection is also before me.

The female differs from that of *mexicana* in structure principally as follows: Occipital carina not sinuate below; postocellar line nearly as long as ocellocular line; frontal horns longer and more acute; sculpture at middle of propodeum irregularly transverse rugosity; ovipositor and sheath distinctly shorter; areolet shorter, with recurrent interstitial.



Differs from *mexicana* in color as follows: Mesosternum yellow only along sternaules; propodeal markings extending only a little before apophyses; hind coxa black above with a large oval yellow spot; basal joint of hind trochanter largely black, apical joint yellow, hind femur black above but with a narrow median yellow line, hind tibia somewhat blackish or brownish at base and apex; petiole black above, yellow below.

The male is very much like the female but has the frontal horns longer and more acute and the hind tibia more broadly black at apex.

15. *CRYPTANURA BILINEATA*, new species

Very similar to the two preceding species, but distinct from both in the form of the propodeal markings, which extend forward to the carina but are abruptly narrowed before the apophyses; in the less distinctly thickened and flattened antennae; in having the frontal horns set rather high on a common base; in the broader and more weakly convex scutellum; and in the short, obtuse apophyses. It is like *mexicana* in general in the color of the legs but has the hind coxa colored as in *orizabensis*; the petiole is, as in *mexicana*, yellow above and black below; and the mesosternum, as in *orizabensis*, is yellow only along the sternaules. In the long postocellar line and in the sculpture of the propodeum it is more like *orizabensis* and in the length of the ovipositor and in venation of the wings it agrees with *mexicana*.

*Type locality*.—Cuernavaca, Morelos, Mexico.

*Type*.—One female in the U. S. National Museum (No. 57064), taken by E. G. Smyth.

16. *CRYPTANURA RUFA*, new species

Distinct from all other species known to me and apparently from all other described species in the arrangement of color, black and yellow head, red and yellow thorax (not black dorsally), and entirely red abdomen.

*Female*.—Length 14 mm., antennae 12 mm., ovipositor sheath 5 mm.

Temples weakly convex, occipital carina not high, with a shallow notch just before its junction with the hypostomal carina; vertex flat, ocelli as high as superior tangent of eyes; frons rather weakly concave, with rugae radiating from ocelli, horns short, stout, rather widely separated; eyes weakly convergent below; face polished and sparsely punctate, weakly convex medially, with a shallow, transversely striate impression on each side of middle; clypeus polished and sparsely punctate, subnasute in profile; malar space three-fourths as long as basal width of mandible; cheeks in front view weakly convex. Thorax robust; humeral margin of pronotum transversely striate, carinately angled anteriorly, scrobe sparsely striate; mesoscutum rather densely

punctate, notaulices deep and narrow, lobes rather flat; scutellum convex, polished, and obsoletely punctate; mesopleuron obliquely striate, this sculpture changing below and posteriorly to rather sparse punctation, sternum more densely punctate; upper division of metapleuron polished and sparsely punctate, lower division coarsely, obliquely rugosostriate; propodeum polished and punctate before and transversely rugosostriate behind carina, posterior face transversely striate, apophyses moderately long and slender; legs rather stout, hind femur hardly reaching apex of abdomen, hind coxae polished and sparsely punctate. Abdomen subpolished, inconspicuously shagreened beyond first tergite; petiole slightly depressed, postpetiole much broader than long, with faint rounded elevations between the spiracles; second tergite about a third longer than broad at base; sheath shorter than abdomen beyond first tergite, ovipositor rather stout, subsagittate at apex.

Head black (see description of color pattern, p. 141) with orbital rings interrupted in upper temple and in malar space; facial impressions and outline of clypeus piceous. Thorax ferruginous, slightly stained with piceous in postscutellar frena and in speculum and with yellow markings; single spot on disk of mesoscutum; scutellum yellow only at apex; upper division of metapleuron and dorsal half of its lower division yellow; propodeal markings including the apophyses and two small spots just in front of and mesad of these. Front and middle legs yellow, with front coxa, trochanter, and femur piceous behind, middle coxa ferruginous with yellow spot in front; hind leg ferruginous with tibia and tarsus yellow. Wings hyaline, venation blackish. Abdomen entirely red.

*Type locality*.—Estero de São Paulo, Brazil.

*Types*.—A female holotype and two female paratypes taken in 1910 by E. R. Wagner. The holotype and one paratype are in the Paris Museum, and the second paratype is in the U. S. National Museum (No. 57081). There is also a female with broken antennae in the Paris Museum, taken in 1910 at Chaco de Santiago del Estero, Argentina.

#### 17. CRYPTANURA SPINARIA (Brullé)

*Mesostenus spinarius* BRULLÉ, Histoire naturelle des insectes, Hymenoptera, vol. 4, p. 227, 1846, female.

*Mesostenus albopictus* CRESSON (not Smith), Proc. Ent. Soc. Philadelphia, vol. 3, p. 312, 1864, male.

*Mesostenus delawarensis* DALLA TORRE, Catalogus hymenopterorum, p. 540, 1901-02.

*Polyacus spinarius* SCHMIEDEKNECHT, Genera Insectorum, fasc. 75, p. 68, 1908.

*Mesostenus spinarius* VIERECK, in Smith, Insects of New Jersey, p. 630, 1910.

*Mesostenidea (Polyaenus) spinaria* VIERECK, The Hymenoptera or wasp-like insects of Connecticut, p. 329, 1917.

*Polyaenus spinarius* CUSHMAN, Journ. Washington Acad. Sci., vol. 15, p. 391, 1925; Proc. U. S. Nat. Mus., vol. 74, art. 16, p. 88, figs. 1d, 3k, 6f, 1929.

*Cryptanura spinaria* TOWNES, Mem. Amer. Ent. Soc., No. 11, pt. 1, p. 268, 1944.

I have described this North American species too recently and too fully to make further discussion necessary here. It may well be mentioned, however, that the mesoscutum frequently has, in addition to the single median yellow spot, traces of the yellow lines along the inner margins of the lateral lobes and sometimes those along lateral margins next to the tegulae.

18. *CRYPTANURA LINEATIFEMUR*, new species

*Female*.—Length 14 mm., antennae 11 mm., sheath 5 mm.

Except that it has a single median spot on the mesoscutum instead of two yellow lines and that the propodeal markings extend narrowly forward to the basal carina, this species is very similar in color and in large part in structure also to the three species *mexicana*, *orizabensis*, and *bilineata*. The hind legs are colored exactly like those of *orizabensis*, as is the mesosternum, while the abdomen is colored like that of *mexicana*. The temples are not at all concave, the cheeks are more convex, the vertex is flat, the occipital carina is lower, the antennae are shorter, the petiole is thicker, with the lateral carinae, both dorsal and ventral, more distinct, and the ovipositor longer; otherwise very similar to *orizabensis*.

*Type locality*.—La Caja, near San José, Costa Rica.

*Types*.—Two females, the holotype and a paratype, taken at the above locality by M. Valeria on July 1, 1931, at an altitude of 900 meters, and one female paratype captured by Schaus and Barnes at Cayuga, Guatemala. All are in the U. S. National Museum (No. 55071).

The Costa Rican paratype is smaller and the Guatemalan paratype larger than the type, but otherwise they are similar.

*Mesostenus veraepacis* Cameron, which seems to be a *Cryptanura*, appears to be very similar to this species but differs in that the hind femur is entirely black above without the yellow median line.

19. *CRYPTANURA COXATA*, new species

*Female*.—Length 16 mm., antennae 12 mm., ovipositor sheath 5.5 mm.

Temples flat, short, and very strongly receding, occipital carina moderately high, somewhat higher and slightly sinuate below; vertex nearly straight across; frons rather deeply concave above, with striae radiating from ocelli, horns short and broad, close together but not on a common base; eyes slightly bulging, weakly convergent below; face polished and sparsely punctate, somewhat rugose below antennae, impressed on each side of middle; clypeus strongly convex, polished, sparsely punctate; malar space about two-thirds basal width of mandible; cheeks in front view weakly convex; antenna 32-jointed, distinctly broadened and flattened beyond middle. Thorax stout; humeral margin of pronotum transversely striate, carinate anteriorly,

scrobe striate; mesoscutum polished and sparsely punctate, lobes somewhat flattened; scutellum convex, polished, very sparsely punctate; upper division of metapleuron polished and sparsely punctate, lower division coarsely, obliquely rugosostriate; propodeum transversely striate behind apophyses, before which it is irregularly rugose, basad of carina polished medially and rugosopunctate laterally, apophyses rather long and slender; legs rather stout, hind femur hardly reaching apex of abdomen. Abdomen stout, subopaque shagreened beyond first tergite; petiole depressed, postpetiole much broader than long with two rather prominent elevations between spiracles; second tergite hardly a third longer than broad at base; sheath much shorter than abdomen beyond first tergite, ovipositor rather stout, subsagittate at apex.

Head and thorax black with yellow markings (see description of color pattern, p. 141); orbital ring interrupted in upper temple; annulus embracing flagellar joints (5)6-10(12); a single spot in center of mesoscutum; large spot on each side of sternum; propodeal markings abruptly narrowed but not constricted before apophyses, and curving toward each other just behind the carina. Front and middle legs yellow, the coxae, trochanters, and femora black behind; hind coxa yellow below and in middle above, black above on outer and inner sides, trochanter black basally, reddish apically, femur ferruginous, tibia and tarsus yellow; wings yellowish hyaline, venation blackish. Abdomen ferruginous, first segment black with petiole dorsally and apical margin yellow.

*Male*.—Much smaller than female, with apical carina complete and strongly arched forward medially, the apophyses reduced to higher elevations in the carina, rugosity of thorax, except in petiolar area, largely replaced by punctation; abdomen much smaller and narrower, legs relatively longer and more slender; clypeus entirely yellow except apical margin; scape beneath; annulus in flagellar joints (10)11-17(18); propodeal markings confluent anteriorly; all abdominal segments beyond first more or less blackish basally.

*Type locality*.—Trinidad Río, Panama.

*Types*.—Two females and one male, the holotype and allotype, taken March 27 and 20, 1912, by August Busck, and a paratype female by W. M. Mann at Ixiamas, Bolivia, in December 1921, on the Mulford Biological Exploration. All are in the U. S. National Museum (No. 57070).

20. *CRYPTANURA BOLIVIENSIS*, new species

Very closely related to *cozata*, from which it can at once be distinguished by the entirely red hind coxa and trochanter and first tergite.

*Female*.—Length 15 mm., antenna 11.5 mm., ovipositor sheath 5 mm.

Differs further from *cozata* as follows: Temples longer and less sharply receding; humeral margins of pronotum subtuberculate

anteriorly; lateral lobes of mesoscutum nearly impunctate; scutellum impunctate; thorax laterally much less strongly striate, mesopleuron mostly punctate rather than striate; abdomen narrower; petiole not depressed, postpetiole not especially broad, though somewhat broader than long, second tergite more than a half longer than broad at base.

Antennal annulus embracing flagellar joints (4) 5-11 (14); propodeal markings strongly constricted before apophyses and not curving mesad anteriorly; middle coxa and trochanter ferruginous behind.

*Type locality*.—Rosario Lake, Rogagua, Bolivia.

*Type*.—One female taken in November 1921 by M. R. López, on the Mulford Biological Exploration. It is in the U. S. National Museum (No. 57072).

#### 21. CRYPTANURA ISTHMUS, new species

*Female*.—Length 15 mm., antenna 12 mm., ovipositor sheath 5 mm.

Structurally almost identical with *coxata*, but differing in color as follows: Mesosternum yellow only along sternaules; propodeal markings constricted basad of apophyses and not curving toward each other anteriorly; hind coxa ferruginous, with an indistinct yellow spot at base above; petiole stramineous, postpetiole piceous with apical margin yellow, second tergite obsoletely yellow just before apex.

*Type locality*.—Trinidad Río, Panama.

*Types*.—Two females, the holotype and a paratype, taken by August Busck at the type locality on March 16 to 19, 1912; and one female paratype taken by C. T. Greene at Ancon, Canal Zone, May 17, 1926. They are in the U. S. National Museum (No. 57073).

#### 22. CRYPTANURA EXCALIBUR, new species

This and the next following two species and probably *Mesostenus platyrus* Brullé form a group distinct from the rest of the genus in the long, stout ovipositor which in side view is almost clavate, becoming gradually much deeper toward the apex. Brullé's species is not known to me, but it may be distinguished from the present species by its red propodeum.

*Female*.—Length 16 mm., antennae 13 mm., ovipositor sheath 9 mm.

Temples very weakly convex, rather short, occipital carina high, especially just before joining hypostomal carina; vertex straight across; frons rather shallowly concave, with rugae radiating from ocelli, horns short, thick, separate; eyes very weakly convergent below; face subpolished, sparsely punctatorugose above, somewhat elevated medially, with a shallow impression on each side of elevation; clypeus strongly convex, polished and sparsely punctate; malar space two-thirds basal width of mandible; cheeks in front view convex; antenna 36-jointed, very slightly thicker and flattened toward apex. Thorax stout; humeral margin of pronotum transversely striate, carinately angled anteriorly, scrobe striate; mesoscutum subpol-

ished and coarsely punctate, lobes weakly convex; scutellum strongly convex, polished, nearly impunctate; mesopleuron obliquely striate above, rather densely punctate below, sternum similarly punctate; upper division of metapleuron polished and sparsely punctate, lower division coarsely, obliquely rugosostriate; propodeum striate behind, the striations becoming somewhat confused above, basad of carina laterally rugose, medially polished and sparsely punctate; apophyses rather stout; legs stout, femur hardly reaching apex of abdomen. Abdomen very finely shagreened and subopaque beyond first tergite; petiole slightly depressed, postpetiole distinctly broader than long, a shallow impression on each side above spiracle; second tergite more than a half longer than broad at base; ovipositor sheath nearly as long as abdomen, ovipositor very stout, nearly twice as deep near apex as at base.

Head and thorax black with yellow markings (see description of color pattern, p. 141); occipital ring nearly or quite interrupted on temple; annulus on flagellar joints (5) 6-11 (13); scape entirely black; mesoscutum with a single median spot; mesosternum yellow only along sternaules; propodeal markings extending broadly forward from apophyses but not reaching carina. Front and middle legs yellow, the coxae, trochanters, and femora black behind; hind leg ferruginous, a small spot at base of coxa above and the tibia and tarsus yellow. Abdomen ferruginous, postpetiole apically and laterally yellow; sheath black.

*Type locality*.—Trinidad Río, Panama.

*Types*.—Three females, all collected by August Busck, the holotype on March 29, one paratype on March 23, 1912, at the type locality, and a paratype on June 3, 1907, at Tabernilla, Canal Zone. They are in the U. S. National Museum (No. 57074).

The paratypes are slightly smaller than the type but otherwise much the same.

#### 23. CRYPTANURA ACINACES, new species

*Female*.—Length 15 mm., antennae (broken), ovipositor sheath 8 mm.

Structure very similar to that of *excalibur*, but abdomen black with yellow markings. From the above description of *excalibur* the present species differs principally as follows: Temples very distinctly convex; horns on a common base; sculpture throughout thorax denser and coarser; apophyses short and stout.

Head and thorax black and yellow (see description of color pattern, p. 141); mandibles entirely black; scape yellow below; annulus on flagellar joints (5) 6-12 (13); orbital ring entire; mesoscutum with a single median yellow spot; scutellum entirely yellow; mesosternum yellow only along sternaules; propodeal markings extending broadly

forward from apophyses, but not reaching carina. Legs ferruginous, tibiae and tarsi yellowish; front coxa yellow in front, black behind; middle coxa yellow in front, piceous to ferruginous behind; hind coxa ferruginous, with a large yellow spot above and a small piceous spot in apical middle; wings yellowish, venation brownish; abdomen black and yellow, petiole entirely black.

*Type locality*.—Colima Volcano, Mexico.

*Type*.—One female in the U. S. National Museum (No. 57075), collected by L. Conrad.

24. *CRYPTANURA PROPINQUA* (Cresson), new combination

*Mesostenus propinquus* CRESSON, Proc. Acad. Nat. Sci. Philadelphia, 1873, p. 152.

*Female*.—Length 13–16 mm.

Structurally very similar to *acinaces* but with temples weakly convex; apophyses rather slender.

Body color almost exactly as in *acinaces* except that the mandibles apparently are always yellow at the base and the orbital rings are very narrow or even interrupted in the temples, and the scutellum is more or less black at the base; but the legs are yellow, with the front and middle coxae, trochanters, and femora piceous behind, the hind coxa with a broad piceous stripe on the outer side of the upper surface and a shorter one on the inner side, the hind trochanter piceous with a trace of yellow on the upper and lower surfaces of the basal joint, and the hind femur piceous above and on the inner surface.

Before me are a paratype and another female from Mexico (Frontera, Tabasco); a pair from San José, Costa Rica (M. Valerio, No. 101); two females from Costa Rica (Paul Serre, 1920); and one female from Nicaragua (Mniszech, 1871), the last three received from the Paris Museum.

The male has the malar space shorter, the frontal horns more slender and separated, the apophyses reduced to high elevations in the apical carina, which is distinct and sharply angulated medially, the petiolar area defined laterally by curved carinae, the apical slope of propodeum not distinctly transversely striate and the space between the carinae longitudinally striate, and the abdomen small and slender and subpolished.

25. *CRYPTANURA PRETIOSA* (Viereck), new combination

*Polyaenidia pretiosa* VIERECK, Proc. U. S. Nat. Mus., vol. 46, p. 382, 1913.

This species differs from all the other species with red abdomen which follow it in the present arrangement in its entirely red front and middle femora and in the form of the yellow marking of the lower division of the metapleuron. The latter is in the form of an oval spot extending forward from the hind coxa, whereas in the other species it either extends the entire length of the sclerite or has an angular forward extension above.

The type and allotype are in the Königliche Zoologische Museum, Berlin, the material examined in this study consisting of a male paratype from Villa Mora, Paraguay, and a female from Georgetown, British Guiana, identified by myself. The latter specimen agrees perfectly with the original description.

This is probably synonymous with *spilonota* (Cameron).

26. CRYPTANURA GRACILIPES, new species

Notable principally for its very slender legs.

*Female*.—Length 14 mm., antenna 12 mm., ovipositor sheath 5.5 mm.

Temples distinctly concave; occipital carina high, especially at lower end, where it curves sharply mesad to join the hypostomal carina far back from the base of the mandible; vertex in front view slightly concave; frons with a few short striae radiating from ocelli; horns short and stout; eyes bulging, weakly convergent below; face somewhat elevated medially, polished and very sparsely punctate, somewhat rugose above and in a shallow impression on each side of middle; clypeus polished and sparsely punctate, subnasute in profile; malar space nearly as long as basal width of mandible; cheeks in front view nearly straight; antenna 35-jointed, slender, distinctly though not strongly thickened and flattened toward apex. Thorax rather unusually smooth, pronotum with humeral margin carinately angled anteriorly, upper portion, including humeral welt, polished and sparsely punctate, scrobe striate; mesoscutum polished, sparsely punctate, lobes weakly convex; scutellum narrow, convex, polished; mesopleuron polished and punctate below, obliquely striate above; sternum and upper division of metapleuron polished and sparsely punctate; lower division of metapleuron coarsely obliquely rugosostriate; propodeum basad of carina polished medially, rugose laterally, behind carina with striae radiating from between apophyses, posterior face transversely striate, basal median area defined, apophyses long and slender; legs very slender, hind femur about eight times as long as deep, more than three-fourths as long as tibia, reaching beyond apex of abdomen. Abdomen rather slender, subpolished; first tergite polished, petiole not depressed, postpetiole broader than long but not abruptly widened at spiracles, rather weakly convex; second tergite about three-fourths longer than broad at base; ovipositor sheath distinctly shorter than abdomen beyond first segment; ovipositor slender and of uniform depth to the distinctly subsagittate apex.

Head and thorax black and yellow, abdomen largely ferruginous (see description of color pattern, p. 141); orbital ring broadly interrupted in temple and narrowly so in malar space; scape entirely black; annulus on flagellar joints (5)6-10(12); mesoscutum with a single discal spot; scutellum black basally; tegula with a broad stramineous and piceous margin; mesosternum yellow only along sternaules;



metapleuron broadly black along lower and anterior margins; propodeal markings barely including apophyses; front and middle legs yellow with femora and front coxa black behind, middle coxa ferruginous behind, hind leg ferruginous, the tibia and tarsus and a small spot at base of coxa above yellow, femur with a narrow dark streak above; wings hyaline, venation brownish; petiole yellow, postpetiole piceous with apical margin narrowly yellow.

*Male*.—Like female but smaller and more slender; frontal horns longer and more slender; antenna 38-jointed; propodeum with apophyses short and thick, apical carina distinct and bent abruptly forward medially; abdomen much more slender, second tergite more than twice as long as broad at base. Annulus on flagellar joints (9)10–16(18); postpetiole only very narrowly yellow at apex.

*Type locality*.—Trinidad Río, Panama.

*Types*.—Two of each sex, a holotype female, allotype male, and a male and a female paratype, all collected at the above locality by August Busck, March 17–30, 1912. They are in the U. S. National Museum (No. 57076).

The paratypes are somewhat smaller than the type and allotype.

#### 27. CRYPTANURA GRACILIS, new species

*Female*.—Length 14 mm., antenna 12 mm., ovipositor sheath 5 mm.

Temples very weakly convex, more than half as broad as short diameter of eye; occipital carina moderately high, curving slightly inward at lower externity, in side view very nearly parallel to posterior margin of eye; vertex straight across; frons with striae radiating from ocelli, horns short and thick, separated; eyes weakly convergent below; face polished, sparsely punctate, transversely striate above and in a shallow impression on each side of a low median elevation; clypeus polished, sparsely punctate, very strongly convex; malar space nearly as long as basal width of mandible; cheek distinctly less than twice as broad as malar space; antenna 38-jointed, slender, barely thickened and weakly flattened toward apex, the joints in the thickened portion fully as long as thick. Thorax distinctly compressed; humeral margin of pronotum transversely striate and with a strong carinate angle anteriorly, scrobe striate; mesoscutum coarsely and rather densely punctate, scutellum narrow; mesopleuron obliquely striate above, finely punctate below; sternum finely punctate; upper division of metapleuron punctate, lower division coarsely obliquely rugosostriate; propodeum with median basal area defined, lateral areas largely rugose but polished and punctate in middle; area behind carina irregularly rugose, posterior face coarsely transversely striate, apophyses long and slender; legs slender, hind femur fully six times as long as deep, and fully three-fourths as long as tibia, but not quite reaching apex of abdomen. Abdomen subopaque, finely shagreened beyond first tergite,

narrow, petiole not distinctly depressed, postpetiole as long as broad, weakly convex; second tergite about three-fourths longer than broad at base, and hardly a half broader at apex than at base; sheath distinctly shorter than abdomen beyond first segment, ovipositor slender, of nearly uniform depth to the subsagittate apex.

Head and thorax black with yellow markings (see description of color pattern, p. 141); orbital ring interrupted in temple; clypeus yellow only in middle, the black of the suture extending upward in the facial impressions; scape entirely black; annulus on flagellar joints (6) 7-19 (12); mesoscutum with a single median spot; scutellum black in basal middle; mesosternum with a small trace of yellow next to sternaules; metapleuron broadly black below and anteriorly; metapleuron posteriorly and metasternum ferruginous; propodeal markings extending only a short distance before apophyses; front and middle legs yellow, black or piceous behind to apices of femora, middle coxa ferruginous behind, hind leg ferruginous with tibia and tarsus yellow; wings hyaline, venation blackish; abdomen entirely ferruginous.

*Type locality*.—Villa Lutecia, near San Ignacio, Misiones, Argentina.

*Type*.—One female in the U. S. National Museum (No. 57083) taken by E. R. Wagner in 1910.

28. CRYPTANURA GENALIS, new species

*Female*.—Length 13 mm., antennae 11.5 mm., ovipositor sheath 5.5 mm.

Very similar to *gracilis*, differing principally as follows: Occipital carina very high, in side view diverging below from posterior margin of eye; frontal horns on a low common base; eyes parallel; clypeus only moderately convex; cheeks strongly convex and fully twice as broad as malar space; antenna 32-jointed, stouter and more distinctly thickened toward apex, the joints in the thickened portion distinctly transverse; mesoscutum very sparsely punctate, prescutum not striate along notaulices; lobes not flattened; scutellum broader; lower division of metapleuron punctatorugose; propodeum without a basal median area, basal region polished, sparsely punctate behind, more densely and coarsely punctate behind carina, rugosopunctate laterally, posterior face closely transversely striate, apophyses very short and thick; legs stouter, hind femur not nearly six times as long as deep and barely two-thirds as long as tibia. Abdomen stouter, postpetiole much broader than long, second tergite barely a half longer than broad at base; sheath as long as abdomen beyond first tergite.

Orbital ring not interrupted in temple; black of clypeal suture not meeting in middle and not extending upward into facial impressions; annulus on flagellar joints (5) 6-11 (13); mesosternum conspicuously yellow along sternaules; propodeal markings triangularly produced

anteriorly; petiole tinged with yellowish and postpetiole with apical margin yellow.

*Type locality*.—Venodio, Sinaloa, Mexico.

*Type*.—One specimen in the U. S. National Museum (No. 57077) received from B. Preston Clark.

29. *CRYPTANURA VARIEGATA* (Brullé), new combination

*Mesostenus variegatus* BRULLÉ, Histoire naturelle des insectes, Hymenoptera, vol. 4, 1846, p. 277, pl. 40, fig. 3.

Closely related to the two preceding species and differing from the above description of *gracilis* only as follows: Temple flat, hardly half as broad as short diameter of eye; clypeus only moderately convex; antenna 32-jointed, distinctly thickened and flattened toward apex, the joints there strongly transverse; scutellum rather broad and more weakly convex; propodeum without defined median basal area, lateral areas largely polished and sparsely punctate, rugose only laterally. Abdomen rather broad, postpetiole broader than long, second tergite more than a half broader at apex than at base.

Clypeus black only apically and laterally, the black not extending upward into the facial impressions; metapleuron and sternum not at all red; annulus on flagellar joints (4) 5-10 (12); propodeal markings extending triangularly nearly to basal carina.

One female in the U. S. National Museum, taken in October 1922 by H. Lang at Kamakusa, British Guiana.

30. *CRYPTANURA PARANENSIS*, new species

*Female*.—Length 13 mm., antennae (tips broken off), ovipositor sheath 6 mm.

Very closely related to *variegata*, from which it is distinguishable by its distinctly longer ovipositor sheath and by the fact that the occipital carina diverges more strongly below from the posterior margin of the eye. From *variegata* it differs further as follows: Frontal horns on a common base; thorax laterally less strongly sculptured, the striation of mesopleuron confined to the upper anterior portion, the punctation of the lower portion and of the sternum finer, and the lower anterior portion of metapleuron smooth and polished; scutellum yellow only at apex and in basal angles; mesosternum entirely black; propodeal markings extending only very slightly forward from apophyses; abdomen somewhat more slender.

*Type locality*.—Peixe Boi, Pará, Brazil.

*Type*.—One female in the U. S. National Museum (No. 57078) taken November 27, 1907, by Miss H. B. Merrill.

What may be the male is represented by three specimens received from the Paris Museum and collected by Manger in Brazil. The labels also bear the figures 11-53. In these specimens the propodeum has a distinctly defined petiolar area from the anterior end of which the apical carina extends laterally and forward to the bases of the

apophyses. The only complete antenna is 43-jointed with the annulus on flagellar points (10) 11-16 (18). The postpetiole is piceous, the middle coxae are very largely ferruginous, while two of the specimens have the mesosternum largely yellowish.

31. *CRYPTANURA TENUITEREBRATA*, new species

*Female*.—Length 17 mm., antennae 15 mm., ovipositor sheath 9 mm.

Conspicuous for its large size and long slender ovipositor, this species is, nevertheless, very closely allied to *paranensis* and *variegata*, differing from the former principally by the characters employed in the key. In structure and sculpture it agrees very well with *variegata*, while in detail of color, especially of scutellum and propodeum, it is more like *paranensis*. The flagellum is somewhat stouter basally than in either of the other two species, the first joint of the flagellum being distinctly less than six times as long as thick, and the antenna is 38-jointed, with the annulus embracing flagellar joints (5) 6-19 (14). The ovipositor sheath is nearly as long as the abdomen and the ovipositor very slender, and of uniform depth to the distinctly subsagittate apex.

*Type locality*.—Rurrenabaque River, Beni, Bolivia.

*Types*.—Two females, the holotype captured in November 1921 by W. M. Mann on the Mulford Biological Exploration; the paratype from Sapucay, Paraguay, October 19, 1902. They are in the U. S. National Museum (No. 57079).

32. *CRYPTANURA INCERTA* (Cresson), new combination

*Mesostenus incertus* CRESSON, Proc. Acad. Nat. Sci. Philadelphia, 1873, p. 161, female.

This and the species next following differ from the preceding six species in the much shorter and stouter hind femur, which is barely two-thirds as long as the tibia. The antenna in this group is somewhat more slender and less strongly thickened and flattened toward the apex. Otherwise these species are, in structure and color pattern, very similar to the preceding group.

*Female*.—Length 11 mm., antennae 11 mm., ovipositor sheath 4 mm.

Temple flat, very strongly receding, distinctly less than half as broad as short diameter of eye; vertex very weakly convex; frons with striae radiating from ocelli, horns very small, on a common base; eyes weakly convergent below; face polished and sparsely punctate, striate above and in longitudinal impressions; clypeus very strongly convex, polished and sparsely punctate; malar space nearly as long as basal width of mandible; much more than half as long as cheek; antenna slender, weakly thickened and flattened toward apex, the joints in the thickened portion weakly transverse. Thorax distinctly compressed; humeral margin of pronotum transversely rugose and carinately prominent anteriorly, scrobes striate; mesoscutum with lobes flattened, polished, sparsely and coarsely punctate; scutellum narrow,

moderately convex, polished, with scattered punctures; mesopleuron striate above, polished and sparsely punctate below, as are also the sternum and the upper division of the metapleuron; lower division of metapleuron coarsely, obliquely striatorugose; propodeum with basal median area defined, lateral areas polished and coarsely, sparsely punctate to rugose, area behind carina irregularly rugose, posterior face transversely striate, apophyses rather long and slender. Abdomen rather stout, minutely alutaceous subopaque, petiole not depressed, postpetiole broader than long; second tergite little more than a half longer than broad at base, its sides broadly divergent; ovipositor sheath hardly as long as abdomen beyond first segment, ovipositor slender, of uniform depth to the subsagittate apex.

Head and thorax black and yellow (see description of color pattern, p. 141); mesoscutum with a single median spot; propodeal markings obliquely truncate shortly anterior to apophyses. Front and middle legs yellow, with coxae, trochanters, and femora black posteriorly; hind leg ferruginous with femur more or less piceous apically, tibia entirely and tarsus except the more or less blackish apex yellow. Wings slightly infumate, especially around apical margin. Abdomen ferruginous, usually with apex of tergite 1 narrowly yellow and postpetiole piceous, though sometimes entirely ferruginous.

Of this species I have examined six females and one male as follows: The National Museum female cotype from Mexico; a female and a male taken by August Busck, March 23 and 27, 1912, at Trinidad Río, Panama; a female from Alhajuelo, Panama, April 7, 1911, A. Busck; and two females from an altitude of 2,000–3,000 feet, "Pinches & Perene Vs," Peru, received from the Geographical Society of Lima.

The Peruvian specimens have the white markings somewhat less extensive, with mandibles and sternum entirely black, and the first tergite entirely red.

### 33. CRYPTANURA MACULIFRONS, new species

*Female*.—Length 11.5 mm., antennae (gone), ovipositor sheath 4 mm.

Similar to *incerta*, from which it differs virtually only as follows: Mesopleuron obliquely striate over most of its surface; face white only medially and in orbits, mandibles entirely black; propodeum dorsally, metapleuron below, and metasternum entirely reddish piceous to ferruginous; white markings of thorax as in *incerta* except that the mesosternum is entirely black; legs as in *incerta* except that the front coxa is very largely piceous and the middle coxa is entirely ferruginous, as is also the abdomen.

*Type locality*.—Misiones, "Env. de San Ignacio, Villa Lutecia," Argentina.

*Type*.—One female in the U. S. National Museum (No. 57082) labeled "E. R. Wagner, 1900."

KEY TO ALL SPECIES OF CRYPTANURA<sup>1</sup>

This key is based partly on specimens and is partly compiled from characters gleaned from published descriptions. Of necessity it depends very largely on color characters and is purely artificial.

1. Thorax red and yellow, rarely partly black above..... 2  
 Thorax black and yellow, rarely propodeum and metasternum more or less reddish..... 9
2. Head red and yellow..... *ruficeps* Cushman  
 Head black and yellow..... 3
3. Abdomen black and yellow..... 4  
 Abdomen more or less, usually largely, red..... 5
4. Mesoscutum immaculate black: mesopleuron red:  
 Propodeum immaculate red..... *albomarginata* (Szépligeti)  
 Propodeum with a black cruciform mark.  
*albomarginata* var. (Szépligeti)  
 Mesoscutum red or piceous with a yellow median spot; mesopleuron largely yellow..... *piceothorax* Cushman
5. Mesoscutum with two small marks discally..... 6  
 Mesoscutum with a single median spot..... 8
6. Mesopleuron white..... 7  
 Mesopleuron red..... *bipartita* (Brullé)
7. Apical carina not developed..... *similis* (Szépligeti)  
 Apical carina developed medially..... *dicostata* Cushman
8. Mesoscutum black..... *variegata* (Brullé) var. 4 (Szépligeti)  
 Mesoscutum red..... *rufa* Cushman
9. Abdomen red..... 10  
 Abdomen black and yellow..... 36
10. Scutellum conical..... 11  
 Scutellum not conical..... 12
11. Metapleuron subconically elevated..... *tuberculata* Cushman  
 Metapleuron not elevated..... *scutellaris* (Szépligeti)
12. Hind femur black above, red or yellow below..... 13  
 Hind femur red, at most black apically..... 15
13. Hind femur yellow below..... *lucida* (Szépligeti)  
 Hind femur red below..... 14
14. Scutellum entirely yellow..... *basimacula* (Cameron)  
 Scutellum yellow only at apex..... *volcanica* (Cameron)
15. Hind coxa black and white..... 16  
 Hind coxa red..... 17
16. Humeral margin of pronotum conically elevated on each side.  
*politigaster* Cushman  
 Humeral margin of pronotum not conically elevated..... *coxata* Cushman
17. Propodeum with a pale spot in each anterior angle..... 18  
 Propodeum immaculate basally..... 19  
[*arcolaris* (Szépligeti), *liopleuris* (Szépligeti), and *longipes* (Szépligeti)  
 and its male variety run to 17 but no farther by the descriptions.]

<sup>1</sup> Specific names whose authors are given in parentheses are here for the first time used in combination with the generic name *Cryptanura*, except in the case of *ectypa* (Cresson) and *spinaria* (Brullé). The names *lamentaria* Cameron, *mexicana* Cresson, *propinqua* Cresson, and *veracipax* Cameron were formerly under *Mesostenus*. The rest of the names here transferred have formerly been under *Polydenua*.

18. Propodeum with yellow spots basally..... *uniformis* Brues  
 Propodeum with reddish spots basally..... *rugosa* Brullé
19. Middle femur entirely black..... *fusciventris* (Cameron)  
 Middle femur not entirely black..... 20
20. Front femur and usually middle femur black or piceous behind or below.... 21  
 Front and middle femora entirely red..... 32
21. Propodeal markings each with a narrow, tongue-like forward extension  
 before apophyses..... 22  
 Propodeal markings truncate basally..... 23
22. Postpetiole red; upper margin of pronotum tuberculate on each side anteriorly.  
*boliviensis* Cushman  
 Postpetiole piceous; upper margin of pronotum merely carinate anteriorly.  
*isthmus* Cushman
23. Mesosternum white at least along sternalia..... 24  
 Mesosternum not at all white..... 20
24. Hind legs very slender, femur apparently nearly 8 times as long as deep;  
 temples in dorsal view very sharply receding and slightly concave.  
*gracilipes* Cushman  
 Hind legs stouter, femur apparently not more than 6 times as long as deep;  
 temples flat or weakly convex..... 25  
 [*variegata* (Brullé) varieties, *nigripes* Brullé, and *striata* Brullé run  
 to 24 but not farther by the descriptions.]
25. Hind femur short, distinctly less than two-thirds as long as tibia; ovipositor  
 sheath barely twice as long as first abdominal segment... *incerta* (Cresson)  
 Hind femur at least two-thirds as long as tibia; ovipositor sheath distinctly  
 more than twice as long as first segment..... 26
26. Cheeks fully twice as broad as malar space; temple rather broad, its angle  
 with the longitudinal axis less than 45 degrees; ovipositor sheath much  
 shorter than abdomen..... 27  
 Cheeks much narrower; temple narrower, its angle with the longitudinal axis  
 more than 45 degrees; ovipositor sheath nearly or quite as long as  
 abdomen..... 28
27. Apophyses short conical; lobes of mesoscutum strongly convex and sparsely  
 punctate; postpetiole broader than long, margined with yellow.  
*genalis* Cushman  
 Apophyses long; lobes of mesoscutum flattened and densely punctate; post-  
 petiole as long as broad, not margined with yellow.... *gracilis* Cushman
28. Hypostomal carina distad of occipital carina shorter than malar space; ovi-  
 positor slender and of nearly uniform depth except at apex.  
*tenuiterebrata* Cushman  
 Hypostomal carina distad of occipital carina as long as malar space, very  
 high; ovipositor stout, much deeper near apex than at base.  
*excalibur* Cushman
29. Head in dorsal view with temples concave and much less than half as long  
 as short diameter of eye; scutellum black medially... *paranensis* Cushman  
 Temples flat and nearly half as long as short diameter of eye; scutellum  
 entirely yellow..... 30
30. Middle coxa black and yellow; face entirely yellow.... *atripectus* Cushman  
 Middle coxa red; face with a black stripe on each side of middle..... 31
31. Ovipositor as long as abdomen and much deeper apically than basally.  
*platyurus* (Brullé)  
 Ovipositor much shorter than abdomen and of uniform depth.  
*maculifrons* Cushman

32. Propodeal spots with tongue-shaped extensions anteriorly. *variegata* (Brullé)  
 Propodeal spots without such extensions anteriorly or, if extending forward  
 from apophyses, the extensions truncate or tapering----- 33
33. Mesosternum black----- 34  
 Mesosternum at least partly yellow----- 35
34. Postpetiole black----- *hyalina* Brullé  
 Postpetiole red----- *conica* Cushman
35. Probably synonymous----- *spilonota* (Cameron)  
*pretiosa* (Viereck)
36. Propodeum with two yellow spots basally----- 37  
 Propodeum immaculate basally----- 42
37. Mesoscutum immaculate discally though sometimes with yellow marginal  
 markings----- 38  
 Mesoscutum with two small markings discally----- 41
38. Mesoscutum immaculate----- *ectypa* (Cresson)  
 Mesoscutum with yellow marginal markings----- 39
39. Mesoscutum with yellow lines laterally opposite tegulae.  
*quadrimaculata* Cushman  
 Mesoscutum with cuneiform markings on anterior lateral margin----- 40
40. Prescutum yellow on each side----- *nitidiuscula* (Cameron)  
 Prescutum immaculate----- *mediostrigosa* Cushman
41. Hind femur black posteriorly----- *bicarinata* Cushman  
 Hind femur with a black line above----- *championi* (Cameron)
42. Mesoscutum with a single median spot or immaculate, rarely (*spinaria*) the  
 median spot flanked on each side by a small mark on inner margin of  
 lateral lobe----- 43  
 Mesoscutum with two discal marks----- 51
43. Mesoscutum immaculate----- *ablata* (Cresson)  
 Mesoscutum maculate----- 44
44. Propodeal spots with tongue-shaped anterior extensions, which rarely become  
 confluent across median line----- 45  
 Propodeal markings without such extensions----- 49
45. Hind coxa red (♀) or black with a yellow spot above (♂).  
*spinaria* (Brullé)  
 Hind coxa yellow with black markings above----- 46
46. Hind femur red----- *septentrionalis* Cushman  
 Hind femur black and yellow----- 47
47. Hind femur black both dorsally and ventrally----- *planiscutellata* Cushman  
 Hind femur black only dorsally----- 48
48. Hind femur with a narrow median yellow line dorsally.  
*lineatifemur* Cushman  
 Hind femur entirely black dorsally----- *veraepacis* (Cameron)
49. Hind coxa and femur red----- *acinaces* Cushman  
 Hind coxa and femur black and yellow----- 50
50. Mesosternum yellow; ovipositor sheath shorter than abdomen.  
*lamentaria* (Cameron)  
 Mesosternum yellow only laterally and on each side of middle posteriorly;  
 ovipositor sheath subequal to abdomen in length----- *propinqua* (Cresson)
51. Mesopleuron with a large yellow spot anteriorly and a small one posteriorly;  
 sternum, petiole, and hind femur entirely black----- *apophysis* Cushman  
 Mesopleuron with a single large oblique mark, joined posteriorly to a yellow  
 line on sternum; petiole partly yellow; hind femur black only above--- 52



52. Petiole black above, yellow below; hind femur with a median yellow line above ----- *orizabensis* (Cameron)  
 Petiole black below, yellow above; hind femur entirely black above.----- 53
53. Mesosternum largely yellow; propodeal spots broadly truncate before apophyses, the latter long----- *mexicana* (Cresson)  
 Mesosternum yellow only along sternaules; propodeal spots narrowed and tongue-like before apophyses, the latter short----- *bilineata* Cushman

### ADDENDUM

#### CREMNOCRYPTUS, new genus

*Genotype*.—*Polyaenus spiniferus* Cameron.

This genus will run in all existing keys to (*Polyaenus* Cresson) = *Cryptanura* Brullé, but the frontal horns are of quite different form, being flattened below and compressed above and separated by a deep groove. It also differs by the following characters: Ocelli situated on the sides of a distinct, sometimes very high, elevation; antenna in female only slightly thickened, slightly flattened on the outer upper side but not below; occipital carina strongly sinuate at lower extremity; mandible distinctly tumid at upper basal angle; upper margins of pronotum tumid, but not angulated anteriorly by the epomia, which are weak or obsolete; notaulices shallow and extending only about halfway to scutellum; sternaules short and shallow; scutellum very broad, very weakly convex, and with sparse, coarse punctures; nervulus interstitial or very nearly so; abdomen coarsely and deeply punctate on basal three tergites, male abdomen fusiform; ovipositor neither distinctly subsagittate nor swordlike, but rather tapering and distinctly flattened above at apex.

#### CREMNOCRYPTUS SPINIFERUS (Cameron), new combination

*Polyaenus spiniferus* CAMERON, Journ. Straits Branch Roy. Asiatic Soc., No. 40, p. 117, 1906.

Five specimens of each sex from Borneo, one female from Mindanao, and two females and one male from Singapore are before me. These agree exactly with Cameron's description.

#### CREMNOCRYPTUS CINGULATUS (Tosquinet), new combination

*Polyaenus cingulatus* TOSQUINET, Mem. Soc. Ent. Belgique, vol. 10, p. 45, 1903.

There can be no doubt that this New Guinea species is congeneric with the genotype. A considerable series, including both sexes, from Mindanao, Basilan, Samar, and Luzon belong, I suspect, to the species, though I hesitate definitely to identify them as such. They differ from *spiniferus* in having the stematicum strongly elevated above the ocelli; the thorax, especially the posterior face of the propodeum, much more sparsely sculptured; the basal tergites more coarsely and less densely punctate; the antennal annulus constantly shorter; and from all but the Mindanao specimen in the blackish color of the entire inner side of the hind tibia.



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NEOTROPICAL LANTERNFLIES OF THE GENUS *PHRICTUS* IN THE UNITED STATES NATIONAL MUSEUM,  
WITH DESCRIPTIONS OF FOUR NEW SPECIES

By JOHN S. CALDWELL

THE Neotropical genus *Phrictus* (Homoptera: Fulgoridae<sup>1</sup>) was established by Spinola in 1839<sup>2</sup> for the unique species *Fulgora diadema* Linnaeus. Since that time various species have been described by Signoret, Distant, Schmidt, Lallemand, and Metcalf; in 1905 Schmidt presented a key to the known species, which was modified by Metcalf in 1938.

For such large and truly spectacular insects the species are relatively little known and their classification is in a confused state, probably because their descriptions have been extremely inadequate and very few have been illustrated. Specific identification has been based largely on color and marking, characters that are often variable in intensity and exactness of pattern, while the structural characters generally emphasized concern the form of the grotesque cephalic process, which in most cases cannot be adequately described. The length of this structure relative to the length of the pronotum has, in the past, served to segregate the species into groups, which in turn have been broken down into the respective species on the basis of color. This method of identification is almost a necessary evil, because the most

<sup>1</sup> Even though *Fulgora* Linnaeus is a synonym of *Laternaria* Linnaeus (Fennah, Proc. Biol. Soc. Washington, vol. 57, pp. 43-44, 1944), in the selection of a family name I follow the principle proposed by C. W. Sabrosky (Verh. VII Int. Kong. Ent., vol. 1, pp. 602-603, 1939).

<sup>2</sup> Ann. Soc. Ent. France, vol. 8, pp. 216-221, 1839.

pertinent structural characters of both the cephalic process and the genitalia defy description. The median notch in the caudal margin of the pronotum and the furcation of the median carina around this notch also furnish constant specific characters. In final analysis the male aedeagus, first illustrated by Metcalf, is of excellent value for identification purposes, but it must be remembered that the aedeagi in the Fulgoridae are inflatable and that they present a very different appearance when inflated than when deflated. The females possess good genital characters in that parts of the first valvulae are heavily sclerotized and ornate with spurs and ridges. Although these valvulae are not radically differentiated among the species, they are relatively constant within each species, and a comparison of the accompanying drawings will readily demonstrate their specific value.

The purpose of this paper is to present the more pertinent structural characters of the genus, together with characters of color and pattern, in the hope that some of the present confusion may be cleared up and that recognition of the species may be made a much easier task.

Because four undescribed species are added here, and because *notatus* Lallemand is not included in any existing key, a revision of the key is presented here. Unfortunately, *xanthopterus* Schmidt<sup>3</sup> and *notatus* Lallemand<sup>4</sup> are known to the writer by their descriptions only. The order in which the species are discussed follows a tentative phylogenetic arrangement.

#### ARTIFICIAL KEY TO THE KNOWN SPECIES OF PHRICTUS

1. Cephalic process flattened apically, transversely arcuate, lacking definite apical teeth..... *auromaculatus* Distant
- Cephalic process with 5 apical teeth..... *quinquepartitus* Distant
- Cephalic process with 3 apical teeth..... 2
2. Hind wings with large hyaline apical spots..... *ocellatus* Signoret
- Hind wings without hyaline apical spots, but small pruinose areas sometimes present..... 3
3. Elytra scarlet, continuous broad yellow transverse fasciae present.  
*tripartitus* Metcalf
- Elytra some shade of green or brown, transverse fasciae if present interrupted medianly..... 4
4. Basal area of hind wing yellow, golden, or orange..... 5
- Basal area of hind wings red to scarlet ..... 8
5. Black or fuscous area in hind wings covering apical three-fourths; cephalic process longer than pronotum..... *regalis*, new species
- Black or fuscous area in hind wings covering apical one-third or less; cephalic process shorter than pronotum..... 6
6. Basal area of hind wings golden yellow; elytra flecked with yellow and brown..... *xanthopterus* Schmidt
- Basal area of hind wings orange..... 7

<sup>3</sup> Ent. Zelt. Stettin, vol. 71, pp. 144-146, 1910 (Ecuador).

<sup>4</sup> Ent. Tidskr., vol. 52, pp. 188, 1931 (Ecuador).

7. Elytra yellowish, irregularly maculate over all with brown; hind wings not maculate----- *sordidus*, new species  
 Elytra brown, maculate in basal two-thirds with small round orange spots; hind wings maculate with brown----- *notatus* Lallemand
- 8 (4). Elytra green in basal two-thirds, with a few small round red or orange maculae; apical third with large brown maculae----- 9  
 Elytra brown or reddish brown----- 10
9. Teeth in apex of cephalic process obtuse, somewhat deflected caudad; median carina of pronotum definitely forked caudad----- *moebiusi* Schmidt  
 Teeth in apex slender, not deflected caudad; pronotal carina not definitely furcate----- *hoffmannsi* Schmidt
10. Elytra some shade of reddish brown, with pink calloused areas present, especially basally; cephalic process toothed on ventral surface.  
*diadema* (Linnaeus)  
 Elytra brown, maculate with yellow; cephalic process smooth beneath-- 11
11. Combined length of cephalic process and head as long as pronotum; expanse of trifurcate apex equal to distance between ocular spines.  
*minutacanthis*, new species  
 Combined length of cephalic process and head longer than pronotum; expanse of apex much greater than distance between ocular spines.  
*punctatus*, new species

**PHRICTUS AUROMACULATUS Distant**

PLATE 7, FIGURES 6, 24, PLATE 8, FIGURES 4, 12; PLATE 9; PLATE 10

*Phrictus auromaculatus* DISTANT, Ann. Mag. Nat. Hist., vol. 16, ser. 7, pp. 672-673, 1905.

There may be some doubt regarding the identity of this species, because Distant makes no definite statement as to whether the apex of the cephalic process is trifurcate or flattened. He does mention the carinate anterior margin and states that the process is shorter than in previously described species. In the specimens studied not only is the process very short but also the apex is flattened and transverse. The color of the hind wings is golden and not bright yellow; otherwise the description matches the specimens. Length over all, male 33 mm., female 36 mm.; elytra, male 26 mm., female 29 mm.

Male bearing the data: "Tumupasa, Bolivia, Dec., Mulford Biol. Expl., 1921-1922 (W. M. Mann)"; female, "Ixiamas, Bolivia, Mulford Biol. Expl., 1921-22 (M. R. Lopez)."

Type locality: Bolivia.

**PHRICTUS OCELLATUS Signoret**

PLATE 7, FIGURES 9, 21; PLATE 8, FIGURE 3

*Phrictus ocellatus* SIGNORET, Bull. Soc. Ent. France, vol. 3, ser. 3, p. v, 1855.

As yet this is the only known species with large hyaline areas within the dark area of the hind wings. The cephalic process is longer than the pronotum. The caudal margin of the pronotum is deeply notched

at the middle with the lateral margins of the notch sharply elevated and acute caudad. Length over all approximately 41 mm.; elytra 32 mm.

One badly damaged female from "Colom." [Colombia?], Baker collection.

Type locality: Venezuela.

**PHRICTUS SORDIDUS, new species**

PLATE 7, FIGURES 3, 20; PLATE 8, FIGURES 1, 13; PLATE 9

Allied to *ocellatus* in general pattern of elytra but lacking ocellate spots in the hind wings. Length, male 40 mm., female 46 mm.; elytra, male 30 mm., female 37 mm.

Dorsum of cephalic process, vertex, clypeus, and median stripe of pronotum light gray. Lateral and ventral margins of process dull cinnamon. Lateral areas of pronotum chocolate-brown. Elytra brown on basal two-thirds, irregularly maculate with dull yellow; broad transverse fascia present at base of reticulate area, broadly interrupted in center by a conspicuous brown dash. Apical third light yellow, maculate with large, irregular brown spots. Hind wings dull faded orange in basal two-thirds, apical third fumate.

Cephalic process shorter than pronotum; trifurcate apex with very obtuse teeth, especially laterally; median tooth somewhat deflexed caudad. Posterior margin of pronotum broadly notched; median carina ending at base of notch. First valvulae in female not trifurcate apically.

Male holotype, U.S.N.M. No. 57224, Ecuador (Goodfellow), Goding collection. Female allotype, Quevedo, Ecuador (F. Campos R.), and one headless female, Ecuador, Goding collection.

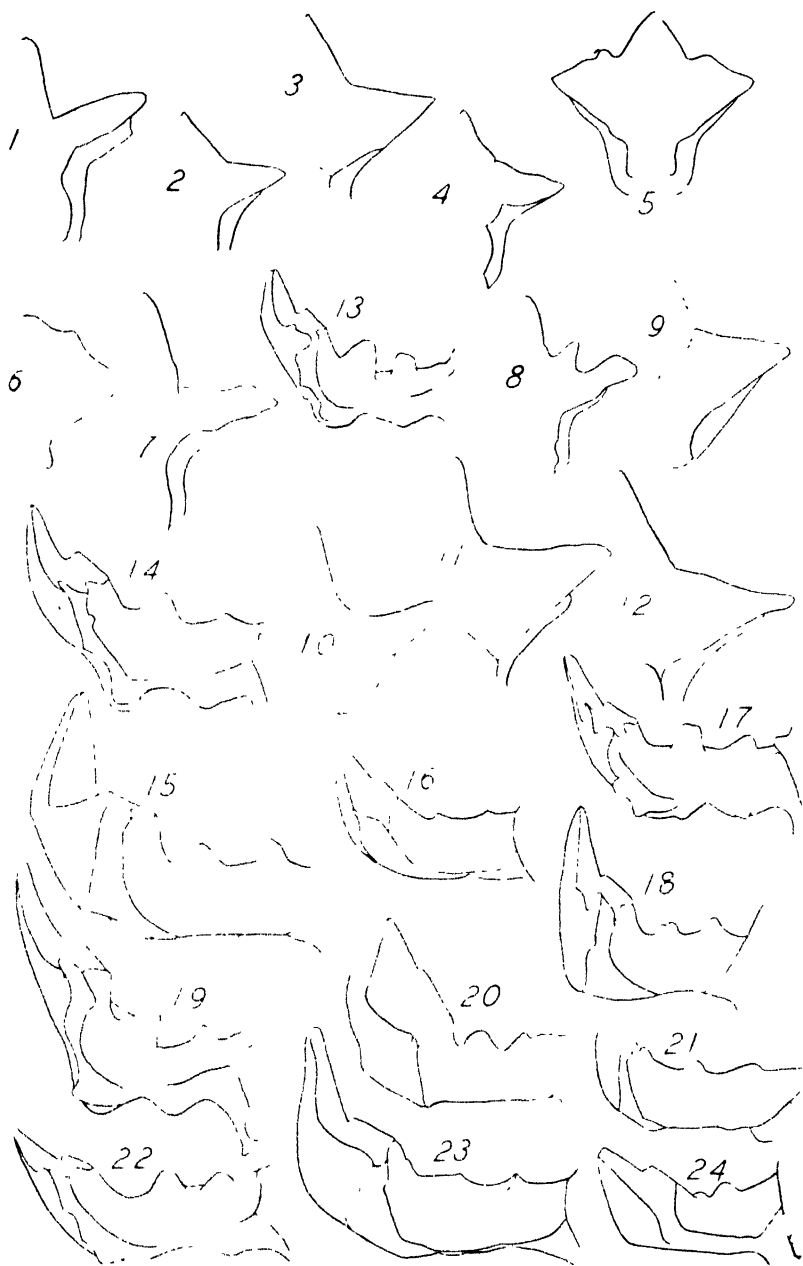
These specimens appear very faded, and it is unknown whether the color is natural or the result of immersion in preserving fluid. With regard to color they resemble the species figured and described by Metcalf as *diadema*; however, the cephalic process is distinctly shorter than the pronotum and therefore they cannot be that species.

**PHRICTUS MINUTACANTHIS, new species**

PLATE 7, FIGURES 2, 16; PLATE 8, FIGURE 2; PLATE 9

Resembles *ocellatus* in color and marking but differs from it in lacking the ocellate areas in the hind wings and having darker brown elytra. It is much smaller and more brightly colored than *sordidus*. Length, female 37 mm., elytra 30 mm.

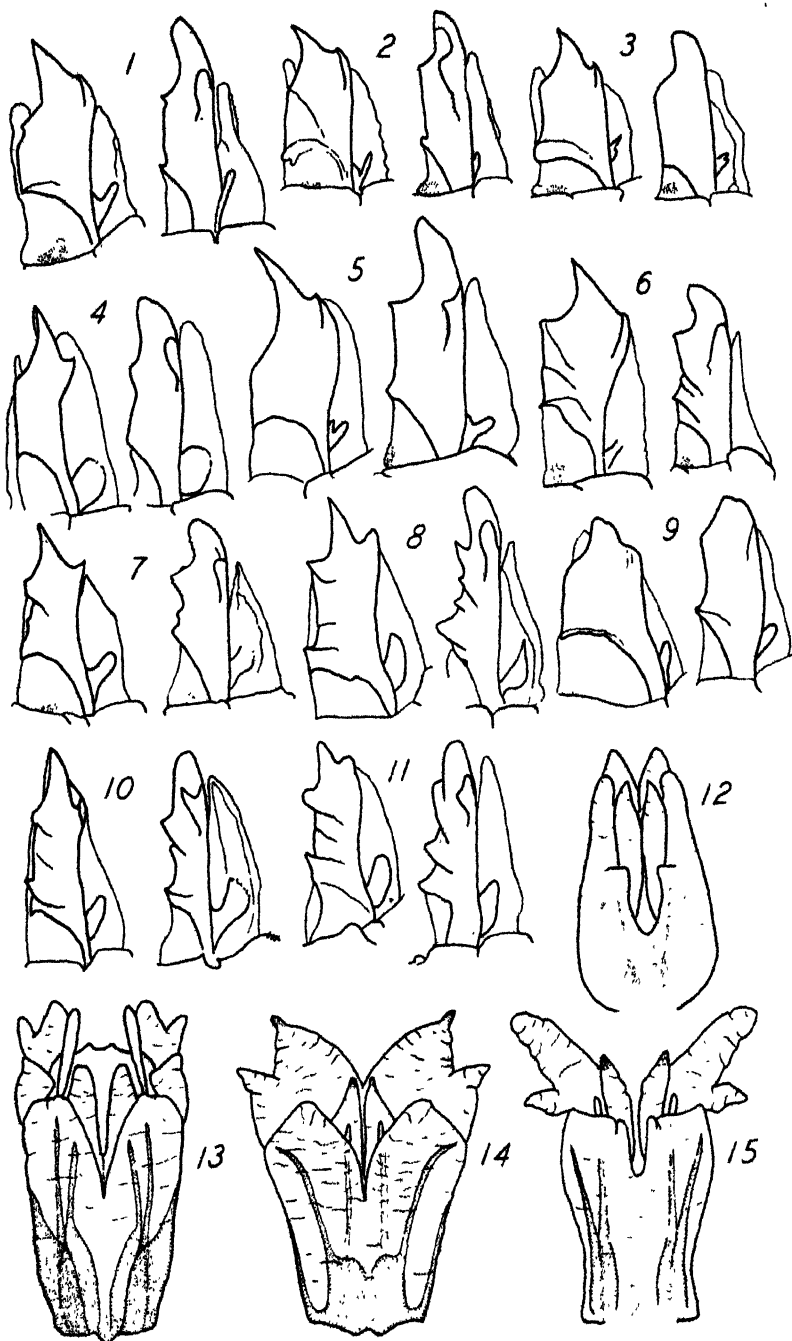
Entire venter, clypeus and face, lateral area of cephalic process, and dorsum of prothorax except median stripe dark brown. Dorsum of head, cephalic process, and median stripe of pronotum dark gray with apex of cephalic process rose to red. Elytra brown, fairly evenly



## CEPHALIC PROCESS IN PHRICTUS.

Frontal profile of right half: 1, *diadema* (female); 2, *minutacanthus* (male); 3, *viridulus* (male); 4, *diadema* (male); 5, *tripartitus* (entire profile, female); 6, *auramaculatus* (female); 7, *regalis* (female); 8, *quinquepartitus* (male); 9, *ocellatus* (female, imperfect); 10, *hoffmanni* (female); 11, *moebiusi* (female); 12, *punctatus* (female).  
 Lateral profile: 13, *diadema* (male); 14, *diadema* (female); 15, *moebiusi* (female); 16, *minutacanthus* (male); 17, *quinquepartitus* (male); 18, *hoffmanni* (male); 19, *regalis* (female); 20, *viridulus* (female); 21, *ocellatus* (female, imperfect); 22, *tripartitus* (female); 23, *punctatus* (female); 24, *auramaculatus* (female).

Owing to their large size, *regalis*, *diadema*, *quinquepartitus*, and *tripartitus* are drawn approximately one-half scale.

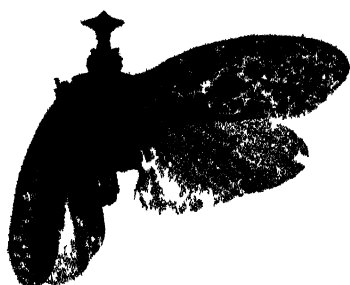


## VALVULA AND GENITALIA IN PHRICTUS.

Lateral and ventral profile of first female valvula (left): 1, *sordidus*; 2, *minutacanthis*; 3, *ocellatus*; 4, *auromaculatus*; 5, *moebiusi*; 6, *punctatus*; 7, *tripartitus*; 8, *regalis*; 9, *hoffmannsi*; 10, *quinquepartitus*; 11, *diadema*.  
 Ventral aspect of male aedeagus: 12, *auromaculatus*; 13, *sordidus*; 14, *diadema*; 15, *quinquepartitus*.



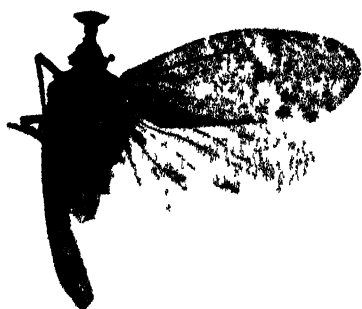
*AUROMACULATUS*



*PUNCTATUS*



*MINUTACANTHUS*



*SORDIDUS*



*TRIPARTITUS*



*QUINQUEPARTITUS*

SPECIES OF PHRICTUS DORSAL ASPECT

*auromaculatus*, female; *punctatus*, female holotype; *minutacanthus*, female holotype;  
*sordidus*, female allotype; *tripartitus*, female; *quinquepartitus*, male.





**REGALIS**



**DIADEMA**



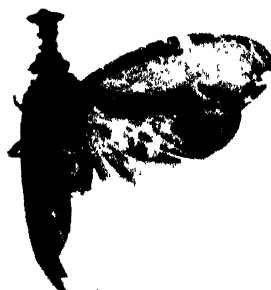
**HOFFMANNSI**



**MOEBIUSI**



**AUROMACULATUS**



**DIADEMA**

SPECIES OF PHRICTUS. DORSAL ASPECT

*regalis*, female holotype; *diadema*, female; *hoffmannsi*, female; *moebiusi*, female; *auro-maculatus*, male; *diadema*, male.

maculate with dull yellow, transverse fascia at base of reticulations irregular and imperfect. Hind wings light red in basal two-thirds, apical third fuscous.

Cephalic process slender, shorter than pronotum; trifold apex very small, especially the median tooth. Caudal margin of pronotum with broad median notch, outer angles of notch abruptly acute and greatly elevated; median carina of pronotum apparently not forked around notch. First valvulae in female short, broad; apices more sharply angled than in *ocellatus*.

Female holotype, U.S.N.M. No. 57225, from Chaquimayo, Peru, February 15, 1918 (C. H. T. Townsend).

**PHRICTUS PUNCTATUS, new species**

PLATE 7, FIGURES 12, 23; PLATE 8, FIGURE 6; PLATE 9

Similar to *minutacanthis* but much larger and with more brightly colored elytra. The cephalic process is longer, with the apical teeth more acute. Length, female 44 mm., elytra 32 mm.

Clypeus very light brown. Face and lateral margins of cephalic process cinnamon-brown. Vertex, dorsum of cephalic process, and median stripe on pronotum dull yellow. Elytra brown with bright-yellow maculae grouped toward the transverse fascia; claval area dull yellow; costal margin with two conspicuous yellow spots before reticulate area; transverse fascia bright yellow, narrow, interrupted in middle by a dark-brown dash more or less surrounded by yellow maculae. Maculae in right elytron tending to form an oblique strip between the dark-brown dash and center of clavus. Hind wings hyaline-carmine in basal two-thirds, apical third light fuscous.

Cephalic process equal in length to pronotum; trifold apex slender, with broader expanse than width of head including eyes. Caudal margin of pronotum broadly concave, with a small notch in middle of concavity. Median carina definitely forked caudally around notch, with surface of pronotum on each side elevated above the forked carina. First valvulae in female with apices broadly concave on outer margins.

Female holotype, U.S.N.M. No. 57226, bearing the following data: "Bugaba, Panama, collection Wm. Schaus." One female paratype from El Volcán, Panama, March 17, 1943, is in the collection of the American Museum of Natural History.

**PHRICTUS HOFFMANNSI Schmidt**

PLATE 7, FIGURES 10, 18; PLATE 8, FIGURE 9; PLATE 10

*Phrictus hoffmannsi* SCHMIDT, Ent. Zeit. Stettin, vol. 66, pp. 338-340, 1905.

This species most clearly resembles *moebiusi* Schmidt but is distinguished from it by a narrower cephalic process, with the apical

teeth slender and lying in the same place. It also resembles *notatus* Lallemand in having the elytra sometimes brownish and maculate, with small, round orange spots, but is separated from *notatus* by having the basal areas in the hind wings red and immaculate instead of orange and maculate with brown.

Length, male 37 mm., female 46 mm.; elytra, male 28 mm., female 37 mm. Unfortunately, pests have destroyed the internal male genitalia.

Represented in the collection by one male with no accompanying data other than "Goding Collection," one female from below Macas, Ecuador (E. W. Rorer), and one female from Baños, Ecuador, altitude 1,800 meters (F. Campos R.).

Type locality: Peru.

#### PHRICTUS MOEBIUSI Schmidt

PLATE 7, FIGURES 11, 15; PLATE 8, FIGURE 5; PLATE 10

*Phrictus moebiusi* SCHMIDT, Ent. Zeit. Stettin, vol. 66, pp. 340-342, 1905.

Resembles *hoffmannsi* in general appearance but differs in having apical teeth of the cephalic process more obtuse, with the median tooth deflexed caudad, elytra possibly lighter green, and with maculae fewer in number but brighter, and apices of first valvulae of female very acute. Hind wings differ from those of *notatus* in that the colored areas are red and scarcely maculate.

One female bearing the following data: "Medellin, Vy. and Porce" (F. L. Gallego M.). Probable locality: Medellín, Colombia.

Type locality: Colombia.

#### PHRICTUS DIADEMA (Linnaeus)

PLATE 7, FIGURES 1, 4, 13, 14; PLATE 8, FIGURES 11, 14; PLATE 10

*Fulgora diadema* LINNAEUS, Systema naturae, ed. 12, vol 1, p. 703, 1767.

Although *diadema* is one of the more common species in the genus, its exact status is evidently still confusing. It was first figured by Stoll,<sup>5</sup> but either the figure is erroneous or *diadema* is unknown today. The hind wing in the figure is unlike that of any known species, and the black color includes a much larger area than in typical *diadema*. The figure by Drury<sup>6</sup> (as *armata*) shows a much more typical pattern, while the photographic reproduction by Costa Lima<sup>7</sup> is *diadema* as accepted by most workers today.

The general color of the elytra varies from light buff to dark shades of brown and sometimes even appears greenish; however, in all this

<sup>5</sup> Representation exactement coloriée d'après nature des Cigales et des Punaises \* \* \* (Cigales), pl. 5, fig. 22, 1780.

<sup>6</sup> Illustrations of natural history, vol. 3, pl. 50, fig. 4, 1782.

<sup>7</sup> Insetos do Brasil, vol. 3, p. 45, fig. 40, 1942.

variation pinkish calloused areas are always present in the basal portions. The trifurcate apex of the cephalic process exhibits much variation as to size, deflection, and form of the teeth. The shape of the internal male genitalia is constant and best shown by the illustration (pl. 8, fig. 14). The apices of the first valvulae in the female are bluntly trifurcate. Five females range in length from 48 to 52 mm. and four males from 41 to 46 mm.

Records indicate that this species ranges through the Guianas into Brazil; also it has been recorded as a minor pest of cacao in Bahia, Brazil. In a letter to the writer, Pedrito Silva states that his reference to *quinquepartitus* Distant appearing in Tropical Agriculture<sup>3</sup> is in error, as the pest on the cacao tree is *diadema* (Linnaeus) and not *quinquepartitus*.

Type locality: "Indien" (probably Brazil).

PHRICTUS REGALIS, new species

PLATE 7, FIGURES 7, 19; PLATE 8, FIGURE 8; PLATE 10

Greatly resembling *diadema* when the elytra are closed but with only the basal fourth of the hind wings yellow. Length 54 mm., elytra 36 mm.

Median stripe on pronotum, vertex, and dorsum of cephalic process gray; apical teeth red. Venter of cephalic process brown, becoming fuscous toward clypeus; clypeus light yellowish. Elytra deep olivaceous, with calloused areas and transverse fascia light red; costal and apical margin lightly washed with black. Hind wings with basal fourth yellow, remainder black, with two or three large red spots present halfway to apex and three or four large yellow spots present in the black area near the basal fourth.

Cephalic process stout, longer than pronotum, length and vertical height about equal; trifurcate apex with long acute teeth. Caudal margin of pronotum scarcely indented medianly; median carina appearing deeply bifurcate. (Unfortunately, most of this area is obliterated by a large pinhole.) Trifurcate apices of first female valvulae with apical and outer teeth acute, inner teeth blunt in lateral aspect.

Female holotype, U.S.N.M. No. 57227, from Maroni River, French Guiana, vicinity of Duserre (G. Moberg).

PHRICTUS QUINQUEPARTITUS Distant

PLATE 7, FIGURES 8, 17; PLATE 8, FIGURES 10, 15; PLATE 9

*Phrictus quinquepartitus* DISTANT, Biologia Centrali-Americana, Homoptera, vol. 1, p. 24, pl. 4, fig. 8, 1888.

This unusual species closely resembles *tripartitus* Metcalf in color and marking but is distinguished from it by the apex of the cephalic

<sup>3</sup> Trop. Agr., vol. 21, p. 12, 1944.

process bearing five teeth. In the 15 specimens examined the apical teeth vary from acute to obtuse, and sometimes the intermediate teeth are much reduced in size. The longitudinal veins in the elytra are not so green as in Distant's illustration, and the bluish-white pruinose spots in the dark apical area on the hind wings are sometimes absent. In addition, the red areas in the hind wings are often less maculate apically with black. The shape of the internal male genitalia appears to be very close to that figured by Metcalf for *tripartitus*; however, the expansion of the inflatable sacs is much less, and the writer believes that these two species are distinct. As in *diadema* the two sexes vary considerably in length, the males ranging between 43 and 45 mm. and the females between 47 and 49 mm.

All specimens are from Panama and the Canal Zone.

Type locality: Panama.

**PHRICTUS TRIPARTITUS Metcalf**

PLATE 7, FIGURES 5, 22; PLATE 8, FIGURE 7; PLATE 9

*Phrictus tripartitus* METCALF, Bull. Mus. Comp. Zool., vol. 82, p. 365, pls. 20, 21, 1938.

Metcalf believes that this species may be the unnamed variety of *diadema* described by Walker<sup>9</sup> and figured in the *Biologia*.<sup>10</sup> In general color, pattern, and size it approximates specimens of male *quinquepartitus* in the collection. Although the aedeagus of the male is of the same general form in both species, it is much more inflatable in *quinquepartitus*; in the female there are differences in the first valvulae.

In the specimen believed to be *tripartitus* the teeth in the trifurcate apex of the cephalic process are very obtuse but between the median and right-hand tooth is a definite bump that may be construed as a vestigial tooth; on the other side of the median tooth the margin is crenulate. This specimen, measuring 51 mm., is longer than any specimen of *quinquepartitus*. The difference in total length is probably accounted for by the longer cephalic process possessed by *tripartitus*.

Female plesiotype from Virginia, Guatemala, November 1915 (Wm. Schaus).

Type locality: British Honduras.

<sup>9</sup> List of homopterous insects in the collection of the British Museum, p. 264, 1851.

<sup>10</sup> *Biologia Centrali-Americana, Homoptera*, vol. 1, pl. 4, fig. 5, 1888.



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**HYPORHAMPHUS PATRIS. A NEW SPECIES OF HEMI-  
RAMPHID FISH FROM SINALOA, MEXICO, WITH AN  
ANALYSIS OF THE GENERIC CHARACTERS OF HYPO-  
RIAMPHUS AND HEMIRAMPHUS**

By ROBERT R. MILLER

THE paucity of our knowledge of the fresh-water fish fauna of northwestern Mexico is evident from the novelties which Ralph G. Miller has collected in that region in recent years. In addition to the distinctive *Dorosoma smithi* Hubbs and Miller (1941) and a new *Gila* being described by me in Copeia, a new species of halfbeak of the genus *Hyporhamphus* is now made known.

About 60 years ago Meek and Goss (1885, p. 221) wrote that the American halfbeaks referred to *Hemiramphus*<sup>1</sup> were "in a condition of great confusion." Although a number of papers dealing with the New World species have appeared since that time, the systematic status and particularly the distribution of the American forms are still far from clear.

The discovery of the new halfbeak, described below, brings up the question of the generic validity of *Hyporhamphus* and has prompted a critical study of *brasiliensis* and *unifasciatus*, the genotypes, respectively, of *Hemiramphus* Cuvier and *Hyporhamphus* Gill. This study has proved to be most productive, for a number of trenchant and easily observed characters, heretofore apparently overlooked, were found. The presence or absence of scales on the upper jaw also was noted by Smith (1933, p. 180). In preparing table 1, in which the genotypes of *Hemiramphus* and *Hyporhamphus* are compared, I examined 135 specimens of *unifasciatus* and 65 specimens of *brasiliensis* in the collections of the U. S. National Museum. These specimens represent

<sup>1</sup> Spelled *Hemirhamphus* by them and by a host of other authors. The original spelling by Cuvier (1817, p. 186) is *Hemi-Ramphus*.

material from the known American range of both species: *unifasciatus*, from Cape Cod to Uruguay in the Atlantic and from San Diego<sup>2</sup> to Peru in the Pacific; and *brasiliensis*, from New York to Brazil.

Gill (1859, p. 131) based *Hyporhamphus* principally on the tricuspid teeth (whence the name of the type species, *H. tricuspidatus*, a synonym of *unifasciatus*), but he later (1863) found, and Poey (1860, p. 298) previously had noted, that *Hemiramphus* likewise has tricuspid teeth. Poey's and Gill's observations on the nature of the teeth were correct, and hence I do not agree with Weed (1933, pp. 47, 57) and others who stated that the teeth are simple in *Hemiramphus*. As Smith (1933) has shown, and as I have also observed, the form and arrangement of the teeth vary with age and with different species. The jaws of a single individual may have unicuspid, bicuspid, and tricuspid teeth, and, in at least one American species, *Hyporhamphus rosae* (Jordan and Gilbert), only the largest individuals appear to have tricuspid teeth—hence the frequent statement that *H. rosae* has only unicuspid teeth.

The fundamental characters distinguishing the American species of *Hemiramphus* and *Hyporhamphus*, such as the presence or absence of scales on the upper jaw, the presence or absence of a bony rim along the side of the nasal fossa, and the arrangement of the sensory canal and pores on the preorbital (fig. 9), may be features that will separate world halfbeaks of this type. This is suggested to me by Smith (1933, pp. 130–131), who made a primary division in his key on the basis of a naked versus a scaled upper jaw, and by the very few Old World halfbeaks I have examined. In *Euleptorhamphus* Gill, however, the upper jaw is scaled as in *Hyporhamphus*, whereas the rim and the form of the nasal fossa and the sensory canal of the preorbital are essentially as in *Hemiramphus*.

The pattern of the scales on the upper jaw, the shape of the preorbital, and the arrangement of the teeth may be found to have generic or only specific value. The solution of these problems will necessitate a comprehensive review of the halfbeaks of the world.

The form of the sensory canal and the pore on the preorbital are usually visible in *Hyporhamphus*, but the overlying scales and skin must be dissected from this bone in *Hemiramphus* before the canal and pores can be clearly seen. The two pores shown near the upper end of the posterior margin of the preopercle in *Hyporhamphus* (fig. 9, A) are apparently absent in *Hemiramphus*, but this character was checked only on a comparatively few individuals of each genus.

In table 1 I have abandoned the "key" characters—air bladder cellular or simple, sides of body vertical or convex, position and shape of

<sup>2</sup> In material from San Diego, Calif. (Stanford Nat. Hist. Mus. No. 9912) I found one specimen of this species, which, to my knowledge, represents a northward extension of known range on the Pacific coast.

dorsal fin, and position of pelvics—used by many writers to separate *Hemiramphus* from *Hyporhamphus*. The nature of the air bladder is difficult to discern but may be of considerable phylogenetic importance; the form of the sides of the body is an untrustworthy character because it is frequently rendered impractical by preservation; the position and shape of the dorsal fin is not so distinctive a feature as is the difference in the basal lengths of the dorsal and anal fins; and the position of the pelvic fins is useful largely for specific or subspecific separations.

TABLE 1.—*Diagnostic differences between Hyporhamphus unifasciatus and Hemiramphus brasiliensis*<sup>1</sup>

Character	<i>unifasciatus</i>	<i>brasiliensis</i>
Upper jaw	Scaled.	Naked.
Margin of nasal fossa (see fig. 9).	Surmounted by a prominent bony rim along posterolateral border.	Lacking a bony rim in this position.
Sensory canal on pre-orbital (see fig. 9).	Unbranched; with an exposed pore on side and another pore at terminus of canal near anterior margin of nasal fossa.	Branched; with a pore at end of posterior branch (which terminates in a bony ridge near front of orbit) and a pore at end of anterior branch near anteroventral margin of nasal fossa.
Dorsal fin	Over or nearly over origin of anal, its base and that of anal equal or subequal.	In advance of anal origin, its base 1.5 to 2.1 times that of anal fin (1.3 or 1.4 in young).
Caudal fin	Moderately forked, the distance between caudal base and shortest caudal rays 7.4 to 9.0 in standard length.	Deeply forked, the distance between caudal base and shortest caudal rays 12.5 to 16.3 in standard length.
Shape of nasal fossa in adult.	Broad, and little depressed, its greatest inner diameter more than one-half that of orbit.	Narrow and greatly depressed, its greatest diameter one-fourth to one-third that of orbit.

<sup>1</sup> Characters of *Hyporhamphus* confirmed on the type specimen (U.S.N.M. No. 3407) of the genus, *H. tricuspidatus* (= *unifasciatus*), and of *Hemiramphus* on "topotypes" (specimens from Jamaica, U.S.N.M. No. 30077) of *H. brasiliensis*.

The new species described below is the first to be definitely recorded from fresh water in the New World. It appears to be restricted to a fluviatile habitat, for a number of collections of halfbeaks along the west coast of Mexico in the region where the new species was discovered contain no species identical with it.

I name this distinctive fish *patris*, genitive of *pater* (father), because my father, Ralph G. Miller, collected the 14 types and only known specimens.

#### HYPORHAMPHUS PATRIS, new species

##### PLATE 11

*Types*.—The holotype (U.S.N.M. No. 129956) is a mature adult (presumably a female, see below), 118 mm. in standard length, and was collected on May 4, 1942, by Ralph G. Miller in Río del Fuerte, one-half mile above the town of El Fuerte, which is about 20 miles northeast of San Blas, Sinola, Mexico. The 13 paratypes (U.S.N.M.



No. 129957), 107 to 130 mm. long, were collected with the holotype. One fish in the lot, a specimen 113 mm. in standard length, is the only individual of the series that has distinctly larger pectoral and pelvic fins. On examination it was found to be a ripe male. One of the others, a specimen 109 mm. long with short pectorals and pelvics, was found to contain eggs in various stages of development, some of them apparently fully mature. The remainder are presumably all females.

*Diagnosis.*—A *Hyporhamphus* with pelvic fins about equidistant between caudal base and gill opening, 21 to 24 gill rakers on lower limb of first arch, with a relatively long mandible (3.6 to 4.2 in standard length), without scales on dorsal or anal fins, and without the fleshy tip of the mandible red.

*Description.*—Body rather slender, its depth 8.0 to 9.6 in standard length, little compressed, the sides rounded; width of body in depth 1.05 to 1.4; head 4.5 to 5.0 in standard length; mandible (measured from tip of upper jaw to end of bony tip) 3.6 to 4.2 in standard length and 0.7 to 0.9 in head length (broken in one specimen); snout 2.8 to 2.9 in head; orbit 4.0 to 4.3 in head, 1.35 to 1.45 in snout, and 1.65 to 1.85 in postorbital; interorbital 3.8 to 4.1 in head and 1.55 to 1.7 in postorbital; length of preorbital 1.5 to 1.65 in orbit; depth of preorbital 1.5 to 1.75 in orbit; width of nasal fossa 1.85 to 2.15 in orbit; base of anal fin 1.01 to 1.08 in base of dorsal fin; pectoral short, 8.4 to 9.35 in standard length in females (7.9 in the male) and 1.75 to 1.95 in head (1.65 in male); pelvic 2.7 to 3.0 in head in females (2.25 in male); midcaudal rays (measured from midbase of caudal fin to tip of shortest middle ray or rays) 8.4 to 9.3 in standard length, 1.7 to 1.9 in head, and 2.1 to 2.4 times the length of the orbit.

The fin rays vary in number as follows: Dorsal 13 to 15, usually 14; anal 15 or 16, usually 16; pectorals 10–10, 10–11, or 11–11, almost always 10–10; pelvics always 6–6. I depart from my usual method in counting the rays of the dorsal and anal fins and regard every element as a separate ray, because this procedure has been followed by virtually all students of this group of fishes. Without exception the first two rays of the dorsal fin are unbranched, and the first two rays of the anal fin are also simple except in two specimens in which the first three rays are unbranched.

The gill rakers on the lower limb of the first gill arch (counted on both sides) vary from 21 to 24.

The lateral series scales (counted from upper angle of gill opening to caudal base) number about 53 to 59, usually 55 to 57; an accurate count is difficult to obtain because the scales are largely missing from the sides.

The pelvic fins lie about equidistant between the base of the caudal fin and the gill opening, varying between the pectoral base and the middle of the opercle. The dorsal fin varies in position from equi-

distant between caudal base and pelvic insertions to much nearer pelvic insertions than caudal base.

The teeth of the holotype are unicuspid, bicuspid, and tricuspid and are arranged in about three to seven irregular rows in the upper jaw and two to five rows in the lower jaw. Tricuspid teeth are present only posteriorly in each jaw and virtually all the anterior teeth (from about the middle of each jaw forward) are unicuspid. In the region where unicuspid and tricuspid teeth intergrade, occasional bicuspid teeth occur. The tooth rows are conspicuously broader medially on each side of the upper jaw than they are at either end, and teeth are

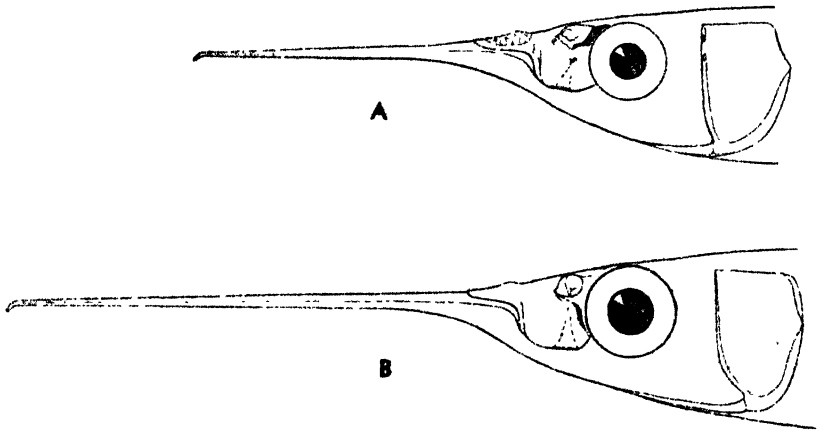


FIGURE 9.—Sketch of head regions of *Hyporhamphus* and *Hemiramphus* to illustrate certain diagnostic differences (see table 1): A, *Hyporhamphus unifasciatus*, 183 mm. in standard length, from Key West, Florida (U.S.N.M. No. 34999); B, *Hemiramphus brassitensis*, 182 mm. long, from Key West, Florida (U.S.N.M. No. 38684). Drawn by Mrs. A. M. Aul, U. S. National Museum.

absent at the tips of both upper and lower jaws. In the lower jaw the rows of teeth are of nearly uniform width but are somewhat broader close to the proximal end on each side and then become narrow gradually forward and abruptly behind this region. In the largest paratype (130 mm. in standard length) there are more tricuspid teeth than in the holotype (118 mm. long), which agrees with my observation in *H. rosae* that tricuspid teeth appear with increasing size of the individual (this was also noted in other American *Hemiramphus* and *Hyporhamphus*). Otherwise the teeth of the paratypes have essentially the same form and arrangement as in the holotype.

The triangular upper jaw is rather bluntly pointed at the apex and broader at the base than it is long. When the mouth is closed most of the outer teeth of the lower jaw are exposed. The scales of the upper jaw are irregularly arranged, the transverse rows numbering five or six across the base, then about four, whereas from about the middle to the tip of the jaw they are biserial—with a single scale on each side of

the slight median ridge. Although the scales cross this low ridge posteriorly they do not usually do so anteriorly.

No scales were observed at the tip of the upper jaw, but these may have dropped off. The sides of the head, including the region of the mandible below the jaws, are covered with deciduous scales.

The margins of the prolonged mandible or "beak" are nearly parallel throughout, diverging little until the posterior end is reached. The nasal flap is small.

The dorsal and anal fins are low, highest anteriorly, with rays 3 to 5 longest; these rays in the anal fin are almost three times as long as the last ray, whereas in the dorsal fin the anterior rays are only about twice as long as the last ray, which is slightly prolonged and falls some distance short of reaching the bases of the procurrent caudal rays. The asymmetrical caudal fin is very weakly forked, less so than in any other American species I have seen except *H. rosae*. As in many halfbeaks, the lower caudal lobe is longer.

The air or swim bladder as noted in the single male is simple, without any cellular structure.

*Coloration.*—The general coloration was noted in the field by the collector. When taken from the water the body of the new species was intense blue and green varying in brilliance according to the reflection of light from the surface, the blue and green grading into each other. The fins or the belly are believed to have been yellow or orange. No bright color was seen anywhere on the beak. This observation is important, for most, if not all, of the American halfbeaks have the fleshy tip of the mandible red. According to Herre (1944, p. 9) the Philippine species of *Hemiramphus* (including *Hypporhamphus*) have this tip red, green, or greenish white, depending upon the species. I therefore interpret the lack of red color on this structure in *patriis* as a character of specific value.

The color of the preserved specimens (in alcohol) is mostly light silvery to pale brownish. The back, above the lateral band on each side, is marked with brownish punctulations, which are usually more concentrated on the posterior borders of the scales. Along the middle of the back are three narrow longitudinal rows of dark pigment, broader near the occiput and particularly over the caudal peduncle; the outer rows are more or less continuous past the base of the dorsal but the middle row is disrupted in this region into a series of U- or V-shaped markings between the bases of the rays. The base of the anal fin is marked similarly to that of the dorsal base, but the longitudinal rows of pigment are far less conspicuous. On each side of the body is a dark band, probably silvery in life, which is very narrow anteriorly and broadest between dorsal and anal fins. The upper surface of the anterior part of the head, including the upper jaw, and of the mandible is black; the lower surface of the mandible is finely

pigmented with black chromatophores fading posteriorly so that both chin and throat are largely colorless. The tips of the caudal rays and those of the longer dorsal rays are marked with fine black punctulations; the other fins are mostly pale. Along the underside of the caudal peduncle are three rather irregular longitudinal rows of dark pigment. The silvery peritoneum is overlain by coppery brown and by fine, black punctulations.

*Habitat and associates.*—Río del Fuerte, near El Fuerte, Sinaloa, is a deep river with sand and mud bottom and abrupt rocky banks. On May 4, 1942, when the types were collected, the current was fairly swift, and hauls with a 25-foot bag seine were made in water generally 1 to 5 feet deep but more than 6 feet in places. At noon the air was 87° C. and the water 32° C. No vegetation was seen, and the shore was sandy, with trees along the bank. Collecting was confined largely to the backwaters. The point where the fish were secured is fully 100 miles upstream from the Pacific.

In the large collection made here, the following fishes, tentatively identified, were also seined: A species of cyprinid fish of the genus *Gila*; two specimens of a catfish of the genus *Ictalurus*; cyprinodont fishes of several genera including *Mollienisia sphenops*; six mullets, *Agonostomus monticola*; a large number of the fresh-water atherine *Melaniris crystallinus*; and two gobies, *Awaous* (or *Chonophorus*) *transandeanus* and *Gobiomorus maculatus*. Most of these species are confined to fresh water.

*Range.*—The new species was collected only in the Río del Fuerte. Ralph G. Miller saw halfbeaks in the Río Culiacán at Culiacán, Sinaloa, Mexico, about 150 miles south of El Fuerte and about 40 miles upstream from the Pacific, but the identity of this species is unknown.

*Relationships.*—*Hyporhamphus patris* appears to be the southern representative of *H. rosae* (Jordan and Gilbert) (1880), which is known from San Pedro, Calif., south to the tip of Baja California, then up the west side of the Gulf of California and southward along the mainland of Mexico to Guaymas, Sonora (Evermann and Jenkins, 1891, p. 135; record confirmed by examination of the five specimens from Guaymas in the Stanford Natural History Museum, No. 437). Río del Fuerte, the habitat of *patris*, is about 170 miles south of Guaymas.

The two species agree in most measurements and counts and in the following important characters: (1) Posterior position of the pelvic fins; (2) gill rakers: 21 to 25 on the lower limb of the first gill arch in my counts for *rosae*, 21 to 24 for *patris*; (3) long mandible, which appears to be slightly longer in *rosae*, but a series of comparable sizes would probably eliminate this difference; (4) no scales on the dorsal or anal fins; (5) dentition. The two species differ as shown in the comparison presented in table 2. Some or all of these differences

may vanish when larger series of both species from more localities are available, but it seems best at this time to regard them as distinct species.

TABLE 2.—*Comparison of Hyporhamphus patris and H. rosae*

Character	<i>rosae</i>	<i>patris</i>
Color of mandible.....	Dark red .....	Black.
Fleshy tip of mandible.....	Red .....	Not red.
Scales in lateral series .....	58-65 .....	54-59.
Bony interorbital into length of head.	3.4-3.8 .....	3.8-4.1.
Diameter of orbit into head length.	3.4-4.0 .....	4.0-4.3.
Size.....	Smaller; largest specimen 107 mm. in standard length, usually much less than 100 mm. long.	Larger, largest specimen 130 mm. long and smallest 107 mm.

The posterior position of the pelvic fins and the few gill rakers readily separate *patris* from *Hyporhamphus unifasciatus* (Ranzani), *H. roberti* (Valenciennes) (= *hildebrandi* Jordan and Evermann), *H. snyderi* Meek and Hildebrand, and *H. gilli* Meek and Hildebrand, the other species reported from Middle America (Meek and Hildebrand, 1923, pp. 236-241, pls. 16-17).

*Acknowledgments.*—Material of *Hyporhamphus rosae* was borrowed from the Stanford Natural History Museum, through the kindness of Miss Margaret Storey, and from the Chicago Natural History Museum, through the courtesy of K. P. Schmidt and Mrs. Marion Grey. I am grateful for this cooperation.

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*HYPORHAMPHUS PATRIS* NEW SPECIES

Holotype specimen (U. S. N. M. No. 129936), 118 mm. in standard length. Photograph retouched by Mrs. A. M. Awl.







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NOTES ON RECENTLY MOUNTED REPTILE FOSSIL SKELETONS IN THE UNITED STATES NATIONAL MUSEUM

By CHARLES W. GILMORE\*

SKELETON of a nearly complete Eocene crocodile and a partial skeleton of *Corythosaurus*, a crested dinosaur of the Upper Cretaceous, have recently been added to the exhibition collection of fossil vertebrates in the United States National Museum. In the brief notes presented here, attention is called to some of the more interesting anatomical features of these specimens, and measurements are given of all the more important bones in order to make these data available to students of the fossil Reptilia. The crocodile specimen appears to be unique in being the first complete skeleton to be mounted for exhibition in this country.

SKELETON OF *CROCODYLUS CLAVIS* COPE

PLATES 12-15

Among the specimens collected by the 1930 Smithsonian Paleontological Expedition to the Bridger Basin in southwestern Wyoming was an unusually complete skeleton of a crocodile, U.S.N.M. No. 12719. It was found by George B. Pearce in the badlands between Levett and Little Dry Creeks in horizon B of the Bridger formation. The skeleton as it lay in the ground was only partially articulated, but inasmuch as it is an isolated specimen the few bones found detached and scattered can surely be regarded as pertaining to a single individual. The skeletal parts preserved are as follows: Skull, lower jaws, 23 presacral vertebrae, 2 sacral vertebrae, 33 caudal vertebrae, 17 chevrons, complete pectoral and pelvic girdles, 10 cervical ribs, 17

\*Mr. Gilmore died on September 27, 1944.—Ed.

thoracic ribs whole or in part, right humerus, both radii, right ulnare, both radialis, parts of 2 metacarpals, both femora, both tibiae, both fibulae, both tarsi, all metatarsals, 11 phalangials, 2 unguals, and numerous dermal scutes.

On account of the rarity of good crocodilian skeletons in palaeontological collections, it seemed desirable to articulate this specimen for public exhibition. After several months' work this was accomplished by Norman H. Boss, chief preparator, who is to be highly commended on the excellent results achieved.

The individual bones are thoroughly mineralized and practically free from postmortem distortion. A few elements, however, either through injuries or disease are abnormally deformed. The right scapula is a most interesting example of a badly healed fracture. In life the scapula was cleanly broken through the narrowest part of the blade. This upper portion dropped down on the inside of the proximal half for fully an inch below the point of fracture, and there the two parts were securely knitted together by extraneous bony growth. Although this fracture must have been exceedingly painful at the time, after healing the limb undoubtedly continued to function.

The second metatarsal of the left hind foot exhibits a pathologic condition that has enlarged the shaft of the bone to nearly twice its normal size. This lesion can probably be attributed to an injury. Other lesions are found on the left coracoid, anterior thoracic ribs, caudal vertebrae, chevrons, and skull. That this animal was a pugnacious individual and often engaged in combat, probably with others of its kind, is clearly indicated by the considerable number of healed wounds.

There are 23 presacral vertebrae preserved, but a restored lumbar was introduced between the first and second, the only point showing evidence of a break in the series, in order to make the presacrals correspond in total number to the vertebral formula of *Crocodylus americanus* as determined by Mook.<sup>1</sup> This introduction makes four lumbar vertebrae, whereas Mook recognizes only three in *C. americanus*; but as a mounted skeleton of this species (U.S.N.M. No. 14874) has four, it seems reasonable to assume that a similar variation may occur in the fossil species.

The caudal series consists of 37 vertebrae of which 33 are original bones. Four vertebrae at the tip of the tail are fully restored. According to authorities the total number of caudal vertebrae is subject to considerable variation among living individuals of the same species.

The skeleton, over all from tip to tip, measured along the curves of the spinal column has a length of about 9 feet 10 inches.

Pending the publication of the monographic study of the Croco-

<sup>1</sup> Mook, C. C., Bull. Amer. Mus. Nat. Hist., vol. 44, pp. 70-78, 1921.

dilia by Dr. C. C. Mook, this specimen is provisionally identified as pertaining to the species *Crocodylus clavis* Cope. Hay<sup>2</sup> recognizes 10 species of *Crocodylus* from the Bridger formation alone, but a thorough revision would doubtless greatly reduce this list.

The mounted skeleton has been given a defiant attitude (see pl. 13) with the jaws agape in order better to display the mouthful of teeth. The pose and style of mount adopted were largely determined by the character of the skeleton. Because of the extreme hardness and brittleness of the fossilized bone, it was found impractical to drill the bones for securing them to metal supports, and so Mr. Boss worked out a scheme of half relief and half free mount that overcame this difficulty and gives pleasing results, as is clearly shown in plates 12 and 13.

The skull and lower jaws are unusually complete and only slightly distorted by crushing.

In the upper and lower mandibles there are alveoli for 76 teeth, premaxillaries 10, maxillaries 30, and dentaries 36. Of this dental series 29 teeth were found in place; enumerated from the front these were distributed as follows: Second of the right premaxillary, a germ tooth, and fourth of the left premaxillary; in the right maxillary the fifth, ninth, tenth, and eleventh, none in the left maxillary; in the left dentary the first, fourth, fifth, sixth, seventh, (germ tooth), eighth (germ tooth), ninth (germ tooth), tenth, and eleventh; in the right ramus the first, second, third, fourth, fifth, sixth, seventh, eighth (germ tooth), twelfth, thirteenth, fifteenth, sixteenth, seventeenth, and eighteenth (the last four being germ teeth).

The other teeth, some 39 in all, were found loose in the matrix surrounding the skull, and these have been arbitrarily inserted in the jaws. Thus of the 76 teeth forming the complete dental series, original tooth crowns of 69 are preserved.

In *Crocodylus*, according to Mook,<sup>3</sup> all the living species of the genus have 17 to 19 teeth in the upper series and only 15 in the lower, or a maximum total of 68 teeth in the mouth as contrasted with 76 in the extinct species. Of 4 other skulls from the Bridger in the National Museum's collections none shows less than 36 in the lower dental series, and it is evident that the greater number of teeth constitutes an important feature for distinguishing the extinct Eocene forms from the extant members of the genus. It also raises the question of the propriety of referring these Eocene crocodiles to the genus *Crocodylus*. That, however, is outside the scope of the present paper, and no doubt will be fully considered by Mook in the course of his monographic study of the order.

<sup>2</sup> Hay, O. P., Bibliography and catalogue of fossil vertebrates. Carnegie Inst. Washington Publ. 390, pp. 512-513, 1928.

<sup>3</sup> Mook, C. C., Bull. Amer. Mus. Nat. Hist., vol. 44, p. 151, 1921.

The excellent preservation of the present skeleton offers an unusual opportunity for recording the important measurements of a single individual of an Eocene crocodile. In the tables that follow the principal measurements of the skeletal parts are given, following Mook's

TABLE 1.—*Comparative measurements (in mm.) of skull, pelvic, and limb bones in two species of Crocodilus*

Measurements	<i>C. clavis</i> (U.S.N.M. No. 12719)	<i>C. americanus</i> (A.M.N.H. No. 7139)
Length of skull, tip of snout to supraoccipital.....	418	735
Length of skull, tip of snout to ends of quadrates.....	481	793
Breadth of skull, cranial table.....	110	181.5
Breadth of skull, across fifth maxillary tooth.....	126	185
Length of mandible.....	535	895
Length of scapula, total.....	136	220
Anteroposterior diameter of superior border.....	77.3	83
Anteroposterior diameter of inferior border.....	75.4	89
Maximum thickness of distal end.....	27	34
Length of coracoid, total.....	101	199
Anteroposterior diameter, superior surface.....	60.4	84
Anteroposterior diameter, inferior surface.....	68.5	83
Length of humerus, total.....	180	168
Breadth of proximal end.....	54	71
Breadth of distal end.....	50.5	67
Circumference of shaft.....	61	69
Index of circumference over length.....	338	410
Length of radius, total.....	107	149
Maximum diameter, proximal end.....	26	34
Maximum diameter, distal end.....	20.1	31
Length of ulna, total oblique.....	125.6	171
Length of ulna, total anteroposterior.....	105	153
Distance across both ischiadic processes.....	145	107
Maximum length of ischium, oblique.....	139	175
Anteroposterior diameter, proximal end.....	49	31
Maximum diameter, distal end.....	68	83
Length of pubis, total.....	93.5	175
Maximum diameter, proximal end.....	27	31
Minimum diameter, proximal end.....	17.4	27
Breadth distal end.....	73.5	87
Length of femur, total.....	223	325
Breadth, proximal end.....	51.5	68
Breadth, distal end.....	51.5	70.5
Circumference of shaft.....	76	110
Distance from center of fourth trochanter to proximal end.....	81	115.5
Distance from center of fourth trochanter to distal end.....	142	209.5
Index ratio {Center of fourth trochanter to proximal end Center of fourth trochanter to distal end}	0.570	0.551
Length of tibia, total.....	159	227
Maximum diameter, proximal end.....	43.1	50
Maximum diameter, distal end.....	38	51
Length of fibula, total.....	156	211
Maximum diameter, proximal end.....	25	33.5
Maximum diameter, distal end.....	24	31
Circumference of shaft.....	35	52
Index ratio {Circumference of shaft Total length}	0.223	0.246

1 Possibly an error, in view of greater proportions of most of the other measurements.

Listed in chronological order these are: *C. casuarius* Brown,<sup>9</sup> *C. excavatus* Gilmore,<sup>10</sup> *C. intermedius* Parks,<sup>11</sup> *C. bicristatus* Parks,<sup>12</sup> *C. frontalis* Parks,<sup>12</sup> and *C. brevicristatus* Parks.<sup>12</sup>

Five of the six species were established on skull characters alone and are distinguished chiefly by differences found in the shape and extent of the crest. In the absence of the skull in the specimen under consideration it appears quite impossible at this time to make a definite identification of the species. However, on the basis of similarity of skin pattern and close agreement in proportions to the type specimen of *Corythosaurus casuarius*, as shown in table 4, this specimen is provisionally identified as pertaining to that species.

TABLE 4.—Comparative measurements (in cm.) of two specimens of *Corythosaurus casuarius*

Measurements	U. S. N. M. No. 15493	A. M. N. H. No. 5338, type
Length of longest chevron.....	40	38.5
Ischium, greatest length.....	113.6	103
Ischium, length of terminal foot.....	20	22
Femur, greatest length.....	115.9	108
Femur, position of fourth trochanter from central point to top of femur.....	58.5	58
Tibia, length of tibia and astragalus.....	100.7	100
Fibula, length.....	98.2	95

<sup>9</sup> Brown, Barnum, Bull. Amer. Mus. Nat. Hist., vol. 33, pp. 559-565, pl. 41, 1914.

<sup>10</sup> Gilmore, C. W., Can. Field-Nat., vol. 37, pp. 46-52, 1923.

<sup>11</sup> Parks, W. A., Univ. Toronto Stud., geol. ser., No. 15, pp. 1-57, 13 figs., pls. 1-4, 1923.

<sup>12</sup> Parks, W. A., Univ. Toronto Stud., geol. ser., No. 37, pp. 26-45, pls. 4-8, 1935.



system <sup>4</sup> used in describing the osteology of the extant *Crocodilus americanus*.

For convenience in reference I have included in parallel columns the measurements by Mook of a considerably larger *C. americanus*. In view of the antiquity of the extinct skeleton these measurements show a remarkable similarity of proportions between the living and extinct forms.

TABLE 2.—Comparative measurements (in mm.) of cervical, dorsal, lumbar, and sacral vertebrae

Vertebrae	Length of centrum <sup>1</sup>		Breadth of centrum, anterior end		Spread of prezygapophyses		Spread of postzygapophyses		Spread of diapophyses		Total height	
	U.S.N.M. No. 12719	A.M.N.H. No. 7139	U.S.N.M. No. 12719	A.M.N.H. No. 7139	U.S.N.M. No. 12719	A.M.N.H. No. 7139	U.S.N.M. No. 12719	A.M.N.H. No. 7139	U.S.N.M. No. 12719	A.M.N.H. No. 7139	U.S.N.M. No. 12719	A.M.N.H. No. 7139
Cervical 2.....	40.5	94.5	25	46	.....	30	26	33	51.7	53	79	87
3.....	34	67	25.5	40	26	40	.....	41	41	35.5	88	127
4.....	35	68	27	43	32.2	44	41	40	43	49	96	140
5.....	32.5	66	31	44	41	54	.....	54	51	55	.....	156
6.....	31.9	65	30.7	44	41	61	.....	58	49	58	.....	166
7.....	32.5	64	34	52	50	64	.....	64	60	63	105	167
8.....	31	65.5	.....	56	48.5	68.5	48	63.5	73.3	64.5	.....	175
Dorsal 1.....	32	63	.....	54	55	68	49	62	84	63	122.9	180
2.....	32	65	.....	56	54	66	52.5	63	101	61	121.5	185
3.....	34.9	66	.....	53	53	67	55	70	105	66	.....	180
4.....	36.6	68	32	50	49	76	62.5	79	127	107	118	181
5.....	37	68	33	48	60.5	82	58	81	149	156	95	160
6.....	39	71	33	49	60.5	84	60	79	159	183	90	150
7.....	39	73	33	49	60	82	59.5	76	150	200	88.5	148
8.....	39	73	33.9	50	61	80	58.5	78	160	213	85	145
9.....	41	74	32.8	50	58	81.5	50	78	160	218	80	140
10.....	41	76	34	51	61	80	62	79	160	230	81	140
11.....	41	78	35	57	62	80	54	83	160	242	79	136
12.....	41	79	35	55	63	86	59.5	81	144	275	80	139
Lumbar 1.....	39.9	78	36	55	55	83	55.4	81	136	277	.....	134
2.....	.....	77	.....	56	.....	82.5	.....	81	.....	250	.....	133
3.....	39	77	36.2	56	.....	85	54	85	120	235	83	132
4.....	38	69	33.5	55	.....	88	33.8	84	.....	218	.....	132
Sacral 1.....	42	59	44	60	44	87	28	52.5	155	230	88	135
2.....	43.7	62	30	50	36	55	42.6	53.5	110	202	79.8	142

<sup>1</sup> The measurements of the vertebral centra of the presacral series of the fossil specimen do not include the ball, and so in using these measurements allowance must be made for this omission. This discrepancy was due to the fact that this portion of the backbone was articulated in fixed position before it was decided to take this series of measurements.

<sup>4</sup> *Ibid.*, pp. 71-100.



TABLE 3.—*Comparative measurements (in mm.) of caudal vertebrae*

Caudals	Length of centrum		Breadth of centrum, anterior end		Height of centrum, anterior end		Spread of prezygapophyses		Spread of postzygapophyses		Height total		Spread of transverse processes	
	U. S. N. M. No. 12719	A. M. N. H. No. 7139	U. S. N. M. No. 12719	A. M. N. H. No. 7139	U. S. N. M. No. 12719	A. M. N. H. No. 7139	U. S. N. M. No. 12719	A. M. N. H. No. 7139	U. S. N. M. No. 12719	A. M. N. H. No. 7139	U. S. N. M. No. 12719	A. M. N. H. No. 7139	U. S. N. M. No. 12719	A. M. N. H. No. 7139
1	55.9	73	34.3	51	29	46	45	58.5	34	52	83.9	130	122	196
2	51.7	69	32	50	30	43	-----	59.5	30	48	77	134	132	195
3	51	70	29.4	45.5	31.5	44	-----	54	27	43	83	135	126	186
4	52	73	27	46	31	42	-----	50	-----	40	79	135	116	175
5	55	75	27.4	44.6	28.6	41.5	27.8	46.5	26	38.5	-----	136	-----	166
6	55.7	76	26.9	43	27	38.5	28	45	21	36	75.5	130	112	157
7	53.7	67	25	40.5	24	37	26	42	21	32	-----	132.5	-----	141
8	53.2	77	25	44	25	44	25	37	22	29.5	-----	118	-----	130.5
9	53.5	68	23	34.5	23	36.5	28	37	20.9	32	67.5	103	-----	120
10	53	78	24.4	35.5	24.1	33	24	36.5	19	32	68.5	101.5	-----	118
11	53	77	23	33.5	23	30.5	27	38	21.5	27	71	100	-----	120
12	54.3	74	22	32	22.5	29	22	34	-----	27	67	107	-----	107
13	54	78	22.5	32	22	28	-----	33	-----	23.5	-----	104	-----	88.5
14	53.4	75	21.7	31	23	26	-----	28	-----	25	60	102	-----	44.5
15	-----	72	21.5	29.5	20.5	26	-----	28	-----	24.5	69	102	-----	-----
16	52	75	-----	28.5	-----	26	-----	28	-----	21.5	-----	106	-----	-----
17	52	74.5	19.5	27	21	24	15	25	10	18	-----	105	-----	-----
18	50	73	19	25	21	25	14	22	7	18	-----	118	-----	-----
19	51	70.5	20	20.4	18	23	-----	19	-----	15	-----	109	-----	-----
20	50	70	18	22.5	18	22	14	18	7	11	-----	88	-----	-----
21	49	66	17	21	16.6	20	12.5	15	6	11.5	65.5	96	-----	-----
22	49.8	66	18	20	16	20	11.2	14.5	4	7.5	65	87	-----	-----
23	47.5	65	16	18	16	18	10.5	12.5	4.5	5	-----	82	-----	-----
24	46	63	15	20	15.2	18	-----	10.5	4	3.5	-----	65	-----	-----
25	44.8	60.5	14.5	16	15	17	-----	9.5	4	3.5	-----	50	-----	-----
26	43.6	59	13.5	15	14	15	-----	8	3.9	2.5	-----	50	-----	-----
27	42.5	57	12	13.5	13.1	14	7	6.5	3	1	15	42	-----	-----
28	40.5	53	7	13	7.5	12	6.9	5.5	3	1	45	35	-----	-----
29	39	49	6.3	12	-----	11	6	3.5	-----	1	38.9	-----	-----	-----
30	-----	46	-----	10.5	-----	10	-----	2.5	-----	-----	5	27	-----	-----
31	-----	45	-----	10	-----	9	-----	-----	3	-----	-----	22.5	-----	-----
32	-----	34	-----	9	-----	8	-----	14.5	-----	12.5	-----	-----	-----	-----
33	30.5	34	9	7.5	7	11	-----	-----	-----	1	-----	13.5	-----	-----

<sup>1</sup> Estimates

## NOTE ON DISEASED CROCODILE VERTEBRAE

## PLATE 16

A second crocodile specimen, U.S.N.M. No. 12990, from the Bridger, Eocene, consisting of the greater portion of a skeleton, shows a pathologic condition of two dorsal vertebrae that is almost identical with the lesion described by Moodie<sup>5</sup> on the caudal vertebrae of a sauropodous dinosaur from the Jurassic.

It is a spongy growth that surrounds the intervertebral articular surfaces extending well outward on the sides of both centra (see

<sup>5</sup> Moodie, Roy L., Amer. Journ. Sci., vol. 41, pp. 530-531, 1916

pl. 16). It entirely encircles the centra and has involved two-thirds of the two bones. All evidence of separate structure is practically obliterated. The growth is quite symmetrical on the two sides.

Moodie in the case of the lesion on the dinosaur caudals says: "The enlargement is somewhat suggestive of the lesion of chronic osteomyelitis. It may be a callous growth due possibly to a fracture of the caudal vertebrae; or it may be a bone tumor." Its true nature is, of course, uncertain, but mention is made of this specimen here in order to call it to the attention of students of modern pathology who may be interested in the study of the nature and origin of disease.

Ruffer<sup>6</sup> has reported typical lesions indicating *spondylitis deformans* in the vertebrae of the Miocene crocodile *Tomistoma dowsoni*, from Egypt. In this specimen the extraneous osseous tissue, obviously pathologic, binds the vertebrae together. The new bone, however, is thicker on one side than on the other, and Moodie<sup>7</sup> observes that "in the crocodile as in man the disease is more marked on one side." The symmetrical nature of the lesion in the National Museum crocodile shown in plate 16 would therefore rule out *spondylitis deformans* as being responsible for the development of this abnormality.

#### ON A SPECIMEN OF CORYTHOSAURUS

##### PLATES 17-19

A partial skeleton of *Corythosaurus* recently added to the exhibition series in the United States National Museum consists of the complete articulated tail, pelvis, hind limbs, and feet, with several small patches of skin impressions and ossified tendons. This specimen is mounted in relief so as to display the right side; the sandstone blocks containing the bones have been assembled in the same relationships they occupied in the ground. The preparation and mounting were done by Norman H. Boss, and it was due to his skillful manipulation that so much of the epidermal impressions were preserved.

The specimen (U.S.N.M. No. 15493) was acquired by purchase from the Royal Paleontological Museum of the University of Toronto for use in connection with the Smithsonian exhibit at the Texas Centennial Exposition at Dallas in 1937. It was collected by Levi Sternberg from the Belly River formation, Upper Cretaceous, 2 miles south of Steeveville, on the Red Deer River, Alberta, Canada, in 1933.

From an exhibition standpoint this specimen is of interest in having several patches of skin impressions preserved. When found the

<sup>6</sup> Ruffer, Sir Marc Armand, A pathological specimen dating from the Lower Miocene period. In Appendix to Fourtau's "Contribution à l'Étude Vertébrés Miocènes de l'Égypte," pp. 101-109, illus. Survey Department, Ministry of Finance, Cairo, 1920.

<sup>7</sup> Moodie, R. L., Paleopathology, p. 175, 1923

skeleton was lying on its left side, but the definition of the skin pattern of that side had been dulled or wholly destroyed by the presence of a considerable amount of vegetal matter on which it lay. The bedding plane beneath the skeleton was unusually irregular, indicating that the cross-bedded planes were laid down by currents acting from different directions.

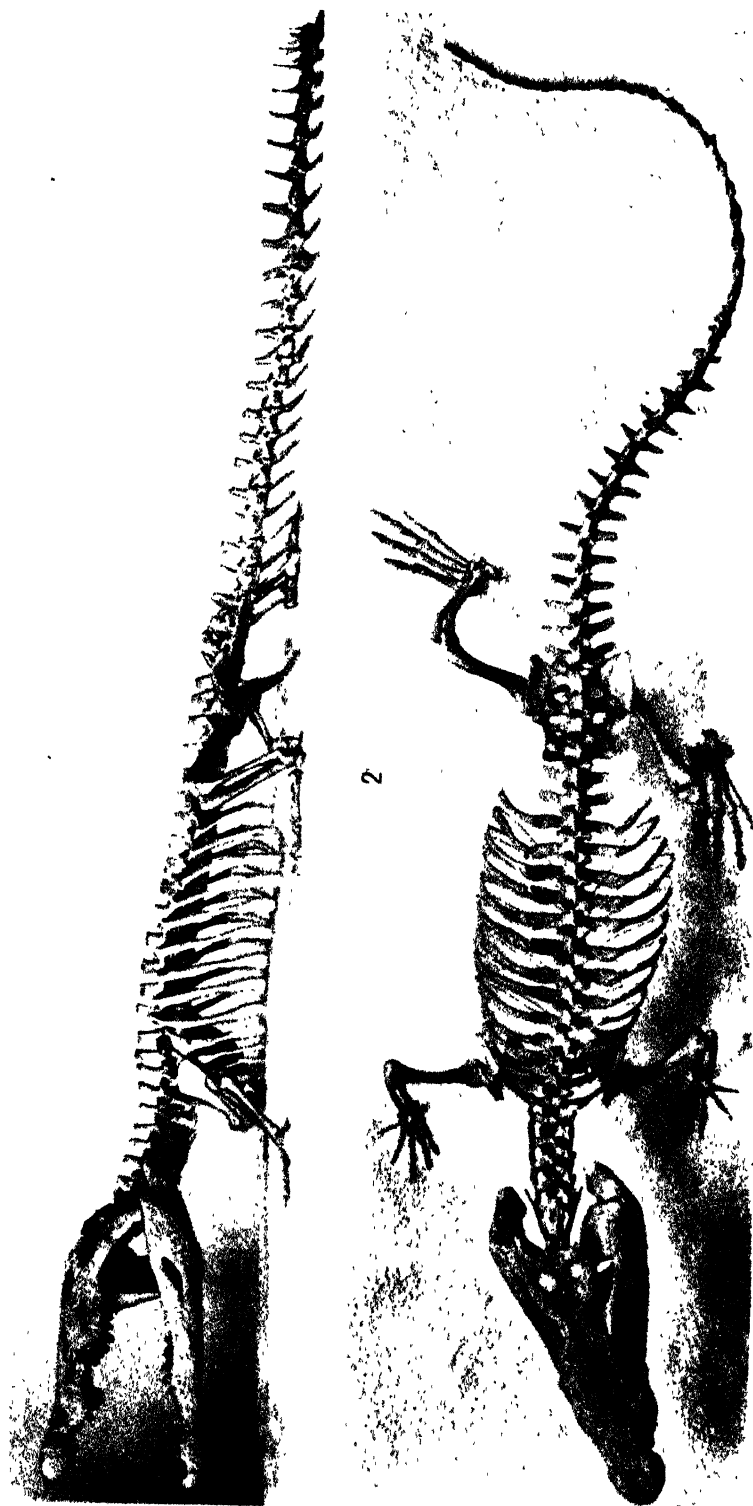
The caudal series consists of 75 vertebrae and appears to be complete. This information, together with that furnished by Brown,<sup>8</sup> shows the complete vertebral formula of *Corythosaurus* to be 15 cervicals, 19 dorsals, 8 sacrals, and 75 caudals. It is presumed, however, that as in many other reptiles the caudal series will be subject to some individual variation in number. The first 16 caudal vertebrae have transverse processes as in the type. The first chevron on the tail of *Corythosaurus* is carried between the fifth and sixth caudal vertebrae; thus the total number of caudal vertebrae can be accurately determined and a close estimate of their combined length can be obtained from this specimen which has the first two caudals completely hidden by the overlying ilium and a patch of skin impressions. Measured along the curve this tail has a complete length of about 455 cm. (14 feet 11 inches).

A complete description of the ossified tendons of *Corythosaurus* has already been given by Brown, and thus it is only necessary to mention that the present specimen fully corroborates his determination that they are disposed in two layers.

Small patches of skin impressions are present on the midsection of the tail, on the pelvis, and on the feet. Those pieces of the integument best preserved cover the thirty-first to the thirty-fourth caudal vertebrae, respectively. The detailed mosaic pattern of the flat, polygonal scales is clearly and beautifully shown in plate 18. Originally the whole midsection of the tail beginning with the sixteenth caudal was covered by skin impressions, but most of the center of this patch was so friable that it could not be preserved. The outside portions, however, outline the original width of the tail at this point. The skin on and below the right ilium is composed of scales, slightly larger than those of the midcaudal region, but otherwise they seem to be indistinguishable. The pattern of the scales on the feet is dim and illy defined and adds nothing to our previous knowledge.

In the course of preparing this specimen many small detached pieces of skin were found in the matrix. Several of these were folded and others had been completely reversed. Six species of this genus have been named, all from the Belly River formation of midwestern Canada.

<sup>8</sup> Brown, Barnum, Bull. Amer. Mus. Nat. Hist., vol. 35, p. 710, 1916.



Mounted skeleton of *Grotodites clausi*, Cope (U.S. N. M., No. 12719). 1, Viewed from the left side; 2, viewed from above. Both figures about one-eleventh natural size.



Skull and lower jaws of *Crocodilus palmarum* (U. S. N. M. No. 12719), lateral view. About one-third natural size.



Skull of *Crocodylus elatus* Cope (U.S.N.M. No. 12719), superior view. About one third natural size.



Skull of *Grindulus carolinensis* (U. S. N. M. No. 12719), palatal view. About one-third natural size.



Diseased dorsal vertebrae of *Crocodilus* sp. (U.S.N.M. No. 12990): Upper figure, ventral view; lower figure, lateral view. Both natural size.

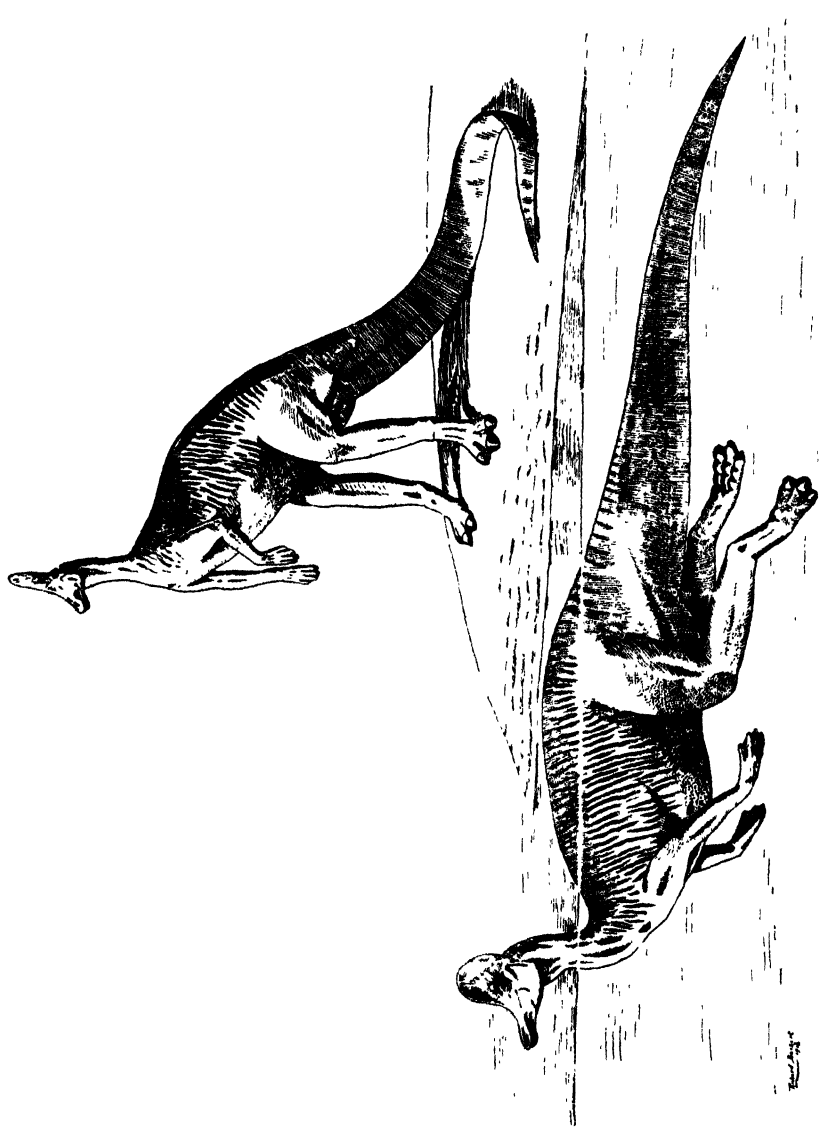




Tail, pelvis, hind limbs, and feet of *Coelocercus* Brown (U.S.N.M. No. 15493), viewed from right side. About one twenty-third natural size.



Skin impressions of *Corythocaerus caucanus* Brown (U S N M No 15493), from the middle of the tail. These impressions cover caudals 31 to 34, inclusive. About one-half natural size.



Restoration of *Coelophysis caninus*. Brown. Drawn by Richard Deckert; after Brown.



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## THE ONYCHOPHIORES OF PANAMA AND THE CANAL ZONE

By AUSTIN H. CLARK and JAMES ZETEK

For the past dozen years the junior author has been interested in collecting and observing the several species of Onychophora occurring in Panama and the Canal Zone. He sent to the senior author a collection including 82 specimens from various localities, among which were representatives of all but one (*Peripatus ruber*) of the species recorded from the region; this omission, however, was more than compensated by the presence of two species (*Oroperipatus eisenii* and *Epiperipatus biolleyi*) not previously known from this area, although the first has been reported both from farther north and from farther south.

The number of species of Onychophora now known from Panama and the Canal Zone is unusually large for a region of such limited extent, amounting to no less than seven, distributed in four genera. These seven species are: *Oroperipatus eisenii*, *O. corradi*, *Macroperipatus geayi*, *Peripatus ruber*, *Epiperipatus brasiliensis*, *E. edwardsii*, and *E. biolleyi*.

The richest locality was at El Cermenó, where four species, *Oroperipatus eisenii*, *O. corradi*, *Epiperipatus edwardsii*, and *E. biolleyi*, were found. Here the coconut habitat was the most productive, and they were rather common. These palms were not more than 5 years old, and the sheaths of the fronds were usually a foot or two from the ground. All it was necessary to do was to pull off these dead sheaths.

It is quite damp where the onychophores are found. There were not many rocks or boards on the ground, which may account for the presence of these creatures under the coconut-palm sheaths.

From Barro Colorado Island three species are now known, *Oroperipatus corradi*, *Macroperipatus geayi*, and *Epiperipatus brasiliensis* var. *vagans*.

Dr. Waldo L. Schmitt has found onychophores in the dry season under rocks where the soil remained moist in a dry stream bed, and *O. eisenii* and *E. biolleyi* have been found under stones by the sides of streams. One species has been found in bromelias in Central America, though not in Panama.

As the records of the species of Onychophora known from Panama and the Canal Zone are widely scattered, it has seemed worth while to include all of them herein, together with a key for their identification and a bibliography.

#### KEY TO THE ONYCHOPHORA OCCURRING IN PANAMA AND THE CANAL ZONE

- a<sup>1</sup>. Urinary papilla of legs IV and V included in third arc of ambulatory pad; 4 foot papillae, 2 on each side of foot.
- b<sup>1</sup>. Urinary papillae of legs IV and V dividing third arc into 2 segments of which the posterior is smaller than the anterior, though much broader than long; urinary tubercle wholly united to anterior portion of arc; 26-29 (usually 28) pairs of legs in females, 24-25 (usually 25) in males; length 14-39 mm.-----*Oroperipatus corradi*
- b<sup>2</sup>. Urinary papillae of legs IV and V dividing third arc into 2 segments of which the posterior is very small, scarcely broader than long; urinary tubercle more or less independent of anterior segment; 27-29 (usually 28) pairs of legs in females, 23-26 (usually 25) in males; length 13-70 mm.  
*Oroperipatus eisenii*
- a<sup>2</sup>. Urinary papilla on legs IV and V below third arc, deeply indenting fourth; 3 foot papillae, 2 anterior and 1 posterior.
- b<sup>1</sup>. Papillae of dorsal surface each on an oblong or squarish base, the oblong bases elongated in direction of long axis of animal; 30-33 pairs of legs in females, 28 in males; length 27-100 mm.----*Macroperipatus geayi*
- b<sup>2</sup>. Papillae of dorsal surface on highly irregular bases, the plications usually appearing undivided.
- c<sup>1</sup>. Principal papillae of dorsal surface of very different sizes, some very conspicuous and cylindrical, others smaller and conical, usually 3 of the smaller between 2 of the larger; papillae separated by rather broad intervals in which accessory papillae occur; males usually with crural tubercles on more than 2 pregenital pairs of legs; 29-30 (usually 30) pairs of legs in females; length 29-52 mm.-----*Peripatus ruber*
- c<sup>2</sup>. Principal papillae of dorsal surface all of same type, passing through all intermediate stages from large to small; papillae closely set, though with occasional accessory papillae between them; in small individuals some of the papillae predominant; crural tubercles of males on 2 pregenital pairs of legs.
- d<sup>1</sup>. On dorsal surface above each pair of legs a few short incomplete plications, tapering to a point on each side intercalated between the others.

- e<sup>1</sup>. Fourth arc on legs IV and V strongly arched beneath urinary papilla, but not divided into segments; urinary papilla attached to third arc by a narrow band at deepest point in incision in latter; 29–34 pairs of legs in females, 28–30 in males; length 23–56 mm.

*Epiperipatus edwardsii*

- e<sup>2</sup>. Fourth arc on legs IV and V broken into 2 or 3 well-separated unequal parts; urinary papilla wholly independent of third arc; 30 pairs of legs in females, 26–28 in males; length 25–36 mm.

*Epiperipatus biolleyi*

- d<sup>2</sup>. No short incomplete plications on the dorsal surface visible in dorsal view, the plications appearing wholly regular; 31–32 pairs of legs in females, 29 in males; length 37–80 mm. *Epiperipatus brasiliensis*

**Genus OROPERIPATUS Cockerell**

**OROPERIPATUS EISENII (Wheeler)**

*Peripatus eisenii* WHEELER, Journ. Morph., vol. 15, pp. 1–8, pl. 1, 1898 (Tepic, Mexico).—FÜHRMANN, Mém. Soc. Neuchât. Sci. Nat., vol. 5, pp. 176–192, 1912 (Rio Purús, Brazil).

*Oroperipatus eiseni* A. H. CLARK, Proc. Biol. Soc. Washington, vol. 26, p. 16, 1913 (listed).

*New records*.—El Cermeno, Panama; J. Zetek, July 8, 1941. *Females*: (1) 55 mm. long, 4 mm. broad, 28 pairs of legs. (2) 52 mm. long, 3.5 mm. broad, 28 pairs of legs. (3) 47 mm. long, 3 mm. broad, 28 pairs of legs. (4) 46 mm. long, 3 mm. broad, 27 pairs of legs. (5) 45 mm. long, 3 mm. broad, 29 pairs of legs. (6) 45 mm. long, 2.5 mm. broad, 28 pairs of legs. (7) 42 mm. long, 2.5 mm. broad, 28 pairs of legs. (8) 37 mm. long, 2 mm. broad, 29 pairs of legs. (9) 30 mm. long, 2 mm. broad, 28 pairs of legs.

El Cermeno, Panama; J. Zetek, July 15, 1941. *Females*: (1) 60 mm. long, 3.5 mm. broad, 28 pairs of legs. (2) 59 mm. long, 3.5 mm. broad, 28 pairs of legs. (3) 55 mm. long, 3.5 mm. broad, 28 pairs of legs. (4) 53 mm. long, 3.5 mm. broad, 28 pairs of legs. (5) 52 mm. long, 3.5 mm. broad, 28 pairs of legs. (6) 50 mm. long, 3.5 mm. broad, 28 pairs of legs. (7) 48 mm. long, 4 mm. broad, 28 pairs of legs. (8) 43 mm. long, 4 mm. broad, 28 pairs of legs. *Male*: (1) 30 mm. long, 2 mm. broad, 25 pairs of legs.

El Cermeno, Panama; J. Zetek, August 5, 1941. *Females*: (1) 60 mm. long, 3.5 mm. broad, 28 pairs of legs. (2) 55 mm. long, 3 mm. broad, 28 pairs of legs.

Panama City, Panama; J. Zetek, September 1939. *Females*: (1) 70 mm. long, 3.5 mm. broad, 28 pairs of legs. (2) 69 mm. long, 4 mm. broad, 28 pairs of legs. (3) 65 mm. long, 3.5 mm. broad, 28 pairs of legs. (4) 64 mm. long, 3 mm. broad, 28 pairs of legs. (5) 61 mm. long, 3.5 mm. broad, 28 pairs of legs. (6) 60 mm. long, 3 mm. broad, 28 pairs of legs.

*Range*.—Mexico (Tepic); Panama (El Cermeno, Panama City); Brazil (Rio Purús).

*Note*.—At El Cermeno this species was found in situations similar to those favored by *O. corradi*.

**OROPERIPATUS CORRADI (Camerano)**

*Peripatus corradi* CAMERANO, Boll. Mus. Zool. Anat. Comp. Univ. Torino, vol. 13, No. 316, pp. 2, 3, 1898 (Ecuador).—BOUVIER, Ann. Sci. Nat., ser. 9, zool., vol. 2, p. 120, pl. 3, fig. 15, pl. 4, figs. 29, 30, text figs. 6, p. 15, 18, p. 20, 42, p. 38, 63, p. 124, and 64, 65, p. 125, 1905.

*Oroperipatus corradoi* A. H. CLARK, Proc. Biol. Soc. Washington, vol. 26, p. 18, 1913 (listed); Smithsonian Misc. Coll., vol. 63, No. 2, p. 1, 1914 (Ancon, Canal Zone; notes); Zool. Anz., vol. 45, No. 4, p. 146, 1914 (Ancon).—FUHRMANN, Abh. Senck. naturf. Ges., vol. 36, Heft 2, pp. 277–283, 1915.—BRUES, Psyche, vol. 32, No. 3, p. 159, 1925 (Canal Zone).

*New records*.—El Cermeno, Panama; J. Zetek, July 8, 1941. *Females*: (1) 32 mm. long, 2 mm. broad, 28 pairs of legs. (2) 30 mm. long, 2.5 mm. broad, 28 pairs of legs. (3) 28 mm. long, 2.5 mm. broad, 27 pairs of legs. (4) 25 mm. long, 1.5 mm. broad, 28 pairs of legs. (5) 16 mm. long, 1.5 mm. broad, 28 pairs of legs. (6) 15 mm. long, 1 mm. broad, 29 pairs of legs. *Males*: (1) 31 mm. long, 2 mm. broad, 25 pairs of legs. (2) 30 mm. long, 2 mm. broad, 25 pairs of legs. (3) 28 mm. long, 2 mm. broad, 25 pairs of legs. (4) 28 mm. long, 2 mm. broad, 25 pairs of legs. (5) 27 mm. long, 2 mm. broad, 25 pairs of legs. (6) 27 mm. long, 2 mm. broad, 25 pairs of legs. (7) 26 mm. long, 1.5 mm. broad, 25 pairs of legs. (8) 23 mm. long, 1.5 mm. broad, 25 pairs of legs. (9) 18 mm. long, 1.5 mm. broad, 25 pairs of legs. (10) 18 mm. long, 1.5 mm. broad, 25 pairs of legs. (11) 18 mm. long, 1.5 mm. broad, 25 pairs of legs. (12) 17 mm. long, 1.3 mm. broad, 25 pairs of legs. (13) 15 mm. long, 1 mm. broad, 25 pairs of legs.

Barro Colorado Island, Canal Zone; J. Zetek, August 1933. *Males*: (1) 33 mm. long, 2.5 mm. broad, 25 pairs of legs. (2) 30 mm. long, 2.5 mm. broad, 25 pairs of legs.

*Range*.—Ecuador (Quito, Balzar, Guayaquil); Canal Zone (Ancon, Barro Colorado Island); Panama (El Cermeno).

*Notes*.—At El Cermeno this species was found between the broad sheaths of old fronds and the trunks of coconut palms roughly 5 years old, and also under boards resting on the ground. On Barro Colorado Island it was usually met with under logs and stones and occasionally with the ground-termite stakes. At Ancon it was found in earth to the depth of about 1 foot about roots of papaya.

**Genus MACROPERIPATUS A. H. Clark****MACROPERIPATUS GEAYI (Bouvier)**

*Peripatus geayi* BOUVIER, Comptes Rendus Acad. Sci. Paris, vol. 128, p. 1345, 1899 (French Guiana); Ann. Sci. Nat., ser. 9, zool., vol. 2, p. 200, pl. 6, figs. 42, 43, text figs. 1, p. 36, and 86, p. 203, 1905.

*Macroperipatus geayi* A. H. CLARK, Proc. Biol. Soc. Washington, vol. 26, p. 17, 1913 (listed); Smithsonian Misc. Coll., vol. 63, No. 2, p. 2, 1914 (from Clark, 1913); vol. 65, No. 1, p. 23, 1915 (from Clark, 1913).

*Peripatus (Macroperipatus) geayi* A. H. CLARK, Smithsonian Misc. Coll., vol. 60, No. 17, pp. 1-5, 1913 (La Chorrera, Panama; notes).—BRUES, Psyche, vol. 32, No. 3, p. 160, 1925 (from Clark, 1913).

*New records.*—Barro Colorado Island, Canal Zone; J. Zetek, July 1941. *Females:* (1) 100 mm. long, 8 mm. broad, 33 pairs of legs. (2) 70 mm. long, 4.5 mm. broad, 31 pairs of legs. (3) 70 mm. long, 4 mm. broad, 30 pairs of legs. (4) 64 mm. long, 4 mm. broad, 30 pairs of legs. (5) 38 mm. long, 3 mm. broad, 33 pairs of legs.

Pedro Miguel, Canal Zone; J. Zetek, April 1938. *Females:* (1) 84 mm. long, 5 mm. broad, 32 pairs of legs. (2) 59 mm. long, 3 mm. broad, 31 pairs of legs. *Males:* (1) 30 mm. long, 2 mm. broad, 28 pairs of legs. (2) 27 mm. long, 1.5 mm. broad, 28 pairs of legs.

Balboa, Canal Zone; J. Zetek, 1944. *Female:* (1) 76 mm. long with 33 pairs of legs.

*Range.*—French Guiana; Colombia; Panama (La Chorrera); Canal Zone (Barro Colorado Island, Pedro Miguel, Balboa).

*Notes.*—On Barro Colorado Island this species occurred under fallen logs and in leaf mold, at Pedro Miguel under stones and boards on the ground. Large onychophores from the Orsini citrus orchard close to La Campana were collected under fallen logs and under stones. These were not seen by the senior author but were presumably of this species.

### Genus PERIPATUS Guilding

#### PERIPATUS RUBER Fuhrmann

*Peripatus ruber* FUHRMANN, Mém. Soc. Neuchât. Sci. Nat., vol. 5, p. 190, 1912 (Rancho Redondo, Costa Rica); Zool. Anz., vol. 42, No. 6, p. 247, figs. 12-14, p. 248, 1913 (redescribed).—A. H. CLARK, Smithsonian Misc. Coll., vol. 65, No. 1, p. 24, 1915 (Lino; from Clark, 1914).—FUHRMANN, Abh. Senck. naturf. Ges., vol. 36, Heft 2, pp. 277-283, 1915.

?*Peripatus (Epi-peripatus) biolleyi* var. *betheli* COCKERELL, Proc. Biol. Soc. Washington, vol. 26, p. 87, 1913 (Puerto Barrios, Guatemala).

*Peripatus (Peripatus) ruber* A. H. CLARK, Zool. Anz., vol. 45, No. 4, p. 145, 1914 (Lino, near Bouquete, Province of Chiriquí, Panama; 4,100-4,500 feet; notes on 3 specimens).

*Range.*—Costa Rica (Rancho Redondo); Panama (Lino, near Bouquete, Province of Chiriquí, 4,100-4,500 feet); ?Guatemala (Puerto Barrios).

*Note.*—From the description Professor Cockerell's *Peripatus (Epi-peripatus) biolleyi* var. *betheli* appears to be *Peripatus ruber*. His type specimen is not at present available for reexamination.

### Genus EPIPERIPATUS A. H. Clark

#### EPIPERIPATUS BRASILIENSIS (Bouvier)

*Peripatus brasiliensis* BOUVIER, Comptes Rendus Acad. Sci., Paris, vol. 129, p. 1031, 1899; Ann. Sci. Nat., ser. 9, zool., vol. 2, p. 269, pl. 7, fig. 63,



pl. 8, figs. 64, 65, text figs. 100–103, p. 273, 1905 (Santarém; ?San Pablo, Panama); Bull. Soc. Philomatique, ser. 9, vol. 10, pp. 50–52, 1908 (Mérida, Venezuela; San Pablo, Panama, confirmed).—FUHRMANN, Mém. Soc. Neuchât. Sci. Nat., vol. 5, p. 190, 1912 (Brazil and Guiana to Panama).

*Epiperipatus brasiliensis* A. H. CLARK, Proc. Biol. Soc. Washington, vol. 26, p. 18, 1913 (listed); Smithsonian Misc. Coll., vol. 63, No. 2, p. 2, 1914 (listed from Panama); vol. 65, No. 1, p. 23, 1915 (San Pablo, Panama; from Bouvier).—FUHRMANN, Abh. Senck. naturf. Ges., vol. 36, Heft 2, pp. 277–283, 1915.

*Peripatus (Epiperipatus) brasiliensis* var. *vagans* BRUES, Psyche, vol. 32, No. 3, p. 162, 1925 (Barro Colorado Island, Las Cascadas, Fort Sherman, and Chinilla, Canal Zone; Río Tapia, Panama; description).

*New records.*—Barro Colorado Island, Canal Zone; J. Zetek, January–May, 1942. *Females:* (1) 50 mm. long, 3.5 mm. broad, 33 pairs of legs. (2) 40 mm. long, 3 mm. broad, 33 pairs of legs. (3) 30 mm. long, 2 mm. broad, 31 pairs of legs. (4) 23 mm. long, 2 mm. broad, 33 pairs of legs. *Males:* (1) 30 mm. long, 2.5 mm. broad, 29 pairs of legs. (2) 18 mm. long, 2 mm. broad, 29 pairs of legs. (3) 17 mm. long, 2 mm. broad, 29 pairs of legs.

Barro Colorado Island, Canal Zone; J. Zetek, August 1933. *Male:* 42 mm. long, 2.5 mm. broad, 29 pairs of legs.

Balboa, Canal Zone; J. Zetek, 1944. *Females:* (1) 55 mm. long, 32 pairs of legs. (2) 52 mm. long, 32 pairs of legs. (3) 13 mm. long, 31 pairs of legs.

*Range.*—Brazil (Santarém); Venezuela (Mérida); Panama (San Pablo, Río Tapia); Canal Zone (Barro Colorado Island, Balboa, Las Cascadas, Fort Sherman, Río Chinilla).

*Notes.*—Individuals from Panama and the Canal Zone represent the variety *vagans* Brues.

On Barro Colorado island this species was usually found under fallen logs in the forest and in leaf mold, occurring also between the broad sheaths of old fronds and the trunk of several of the large palms. It was met with occasionally in the ground-termite nests where it was discovered when the test stakes were pulled up.

#### EPIPERIPATUS EDWARDSII (Blanchard)

*Peripatus edwardsii* BLANCHARD, Ann. Sci. Nat., zool., ser. 3, vol. 8, p. 140, 1847 (Cayenne); Rech. Anat. et Zool. faites pendant un Voyage en Sicile, pt. 3, p. 64, 1849.

*Peripatus edwardsi* BOUVIER, Ann. Sci. Nat., zool., ser. 9, vol. 2, p. 301, pl. 9, figs. 74–79, text figs. 5, p. 15, and 111, p. 308, 1905 (Panama; Darién).—FUHRMANN, Mém. Soc. Neuchât. Sci. Nat., vol. 5, p. 190, 1912 (Brazil and Guiana to Panama).

*Epiperipatus edwardsi* A. H. CLARK, Proc. Biol. Soc. Washington, vol. 26, p. 18, 1913 (listed); Smithsonian Misc. Coll., vol. 63, No. 2, p. 2, 1914 (Isthmus of Panama; from Bouvier); vol. 65, No. 1, p. 23, 1915 (Panama; Darién; from Bouvier).—FUHRMANN, Abh. Senck. naturf. Ges., vol. 36, Heft 2, pp. 277–283, 1915 (listed).

*New Records*.—El Cermeno, Panama; J. Zetek, July 8, 1941.  
*Female*: (1) 35 mm. long, 2 mm. broad, 30 pairs of legs.

Balboa; J. Zetek, 1944. *Females*: (1) 50 mm. long, 34 pairs of legs.  
 (2) 50 mm. long, 33 pairs of legs. (3) 45 mm. long, 33 pairs of legs.  
 (4) 35 mm. long, 33 pairs of legs. (5) 25 mm. long, 33 pairs of legs.  
*Males*: (1) 28 mm. long, 29 pairs of legs. (2) 27 mm. long, 29 pairs  
 of legs. (3) 25 mm. long, 30 pairs of legs. (4) 25 mm. long, 29  
 pairs of legs. (5) 25 mm. long, 29 pairs of legs.

*Range*.—Cayenne; Surinam (Paramaribo); Venezuela (Caracas,  
 Mérida, Valencia, Haut-Sarare, Bas Sarare); Colombia (Santa  
 Marta); Panama (El Cermeno, Panama Station, Panama Railway);  
 Canal Zone (Balboa); Darién.

*Notes*.—At El Cermeno this species was found in situations similar  
 to those frequented by *Oroperipatus corradi*, though more often under  
 boards resting on the ground.

#### EPIPERIPATUS BIOLLEYI (Bouvier)

*Peripatus biolleyi* BOUVIER, Bull. Soc. Ent. France, 1902, p. 258 (San José, Costa  
 Rica); Ann. Sci. Nat., ser. 9, zool., vol. 2, p. 321, pl. 10, fig. 85, text figs. 115,  
 116, p. 323, and figs. 117, 118, p. 324, 1905.

*Epiperipatus biolleyi* A. H. CLARK, Proc. Biol. Soc. Washington, vol. 26, p. 18,  
 1913.—FUHRMANN, Abh. Senck. naturf. Ges., vol. 36, Heft 2, pp. 277-283,  
 1915.—A. H. CLARK, Proc. U. S. Nat. Mus., vol. 85, p. 3, 1937 (Parismina  
 and La Caja, San José, Costa Rica).

*New record*.—El Cermeno, Panama; J. Zetek, July 1941. *Females*:  
 (1) 41 mm. long, 4 mm. broad, 30 pairs of legs. (2) 38 mm. long,  
 3 mm. broad, 30 pairs of legs.

*Range*.—Costa Rica (San José, and La Caja, San José, Surubres  
 near San Mateo, and Parismina); Panama (El Cermeno).

*Note*.—At El Cermeno this species occurred in much the same  
 situations as *E. edwardsii*.

#### ADDENDUM

Dr. Otto Fuhrmann (1912, p. 190) gives *Epiperipatus simoni*  
 (Bouvier) as ranging from Brazil and Guiana to Panama. There are  
 no published records of this species from anywhere west of Venezuela.  
 He also included "Brazil" in the range of *Epiperipatus edwardsii*, but  
 we know of no record of this species from that country.

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# ECHIUROID WORMS OF THE NORTH PACIFIC OCEAN

By WALTER KENRICK FISHER

THE echiuroids, sometimes called spoon worms from the shape of the contracted prostomium or proboscis, are cigar-shaped or sausage-shaped creatures, essentially highly muscular sacs filled with fluid in which the long alimentary canal and other organs have great freedom of movement. The mouth is anterior, usually at the base of a snout or a long proboscis used for gathering food. The skin is highly glandular and is covered by a very thin cuticle. Typically there are two hooked setae behind the mouth, and two genera have either one or two circles of setae at the posterior end of the body. The alimentary canal, in contrast to that of most annelids, is several times the length of body and consists of a long foregut, differentiated into pharynx, esophagus, gizzard, and stomach, a still longer midgut or intestine, accompanied for a considerable part of its length by a collateral intestine, or siphon, and finally a short hind-gut or cloaca, into which empty two usually voluminous, sometimes branched, vesicles, the walls of which are studded with minute ciliated funnels. The anterior nephridia, typically elongate, thin-walled sacs, varying from one to many, but usually from one to four pairs, have a basal or terminal nephrostome, the lips of which may be greatly prolonged and spirally twisted. The nephridia vary greatly in size and when filled with eggs or sperm are often very large. The vascular system consists of a ventral vessel following the nerve cord to form a loop in the proboscis from the tip of which a median vessel passes backward in the proboscis and along the dorsal side of foregut to beginning of midgut, where a neurointestinal vessel joins it to the ventral vessel. In *Urechis* there are no blood vessels.

Echiuroids are burrowers in mud or sand, where they fashion more or less permanent tunnels. Sometimes they live under rocks; sometimes in mud-filled mollusk shells or sand-dollar tests, which afford some protection; or they inhabit the rock galleries excavated by boring clams. Their food consists of organic material contained in the mud which they swallow in large quantities, or of lighter organic detritus selected by the usually long proboscis. In the same species from different localities the intestinal pellets vary with the character of the bottom. One genus (*Urechis*) has very specialized feeding habits and uses only finely divided material, including bacteria. It is probable that any small organisms living in the surface film of mud will be eaten by echiuroids. Gislén (1940, p. 30) found the intestinal pellets of *Echiurus echiurus* "to consist of the same stuff as that which is formed by the detritus-film growing on the aquarium bottom. There are thus plenty of sand grains; further the pellets consist of diatoms, algal threads, debris of leaves of phanerogams (*Zostera* et al.), Infusoria, Bacteria, occasional Nematodes and Rotatoria and, to a large extent, of amorphous brown stuff which emanates from decomposed organic substance."

The smallest sexually mature echiuroid I have ever seen is a *Listriolobus pelodes* 7 mm. long (0.275 of an inch), and the largest is *Urechis caupo*, 470 mm. long preserved, or 18.5 inches. I have seen a relaxed living *Urechis caupo* 19.75 inches long. The Japanese *Ikeda taenioides*, a remarkable and isolated form, attains a body length of 16 inches with a proboscis of 58 inches, or a total length of 6 feet 2 inches (Ikeda, 1907, p. 20).

More helpless, unprotected animals can scarcely be imagined. The immature stages are prey for every predaceous inhabitant of the sea bottom. The adults are regularly eaten by fishes, especially flatfishes and rays, as well as by the Indians of Chiloé Island, Chile (Gay, 1854, p. 475). In Japan and Korea *Urechis unicinctus* is extensively used as bait. Sato (1939, p. 319) states that in Korea the natives catch it by means of iron hooks and dry it for food.

Systematics of the Echiuroidea present the usual problems in addition to others inherent to the group. The principal difficulty is the lack of structures having a permanent form. The setae are of very limited use; everything else is soft and capable of distortion. The practical difficulties encountered are those which would confront the student of holothurians if these creatures did not carry embedded in the skin a species label in the guise of characteristic calcareous deposits. Most of the generic and specific characters of echiuroids must be sought by careful dissection of the internal organs, which are susceptible to variation arising from accidents of fixation. Nevertheless, a fairly satisfactory system of genera can be constructed. But it is obvious that closely related species may not be recognized,

or if recognized they may be impossible to describe in the absence of trenchant characters. Descriptions of echiuroids based on external characters or on a very summary enumeration of a few internal features have made it difficult to determine the generic position of a number of described forms.

It has been a time-honored procedure to classify the echiuroids, sometimes in combination with the sipunculoids and priapuloids, under the name Gephyrea, as a class of the Annelida. In 1898 Prof. Adam Sedgwick, in his "Students' Textbook of Zoology," set up separate phyla for the Sipunculoidea and Priapuloides but retained the Echiuroidea as a class of the Annelida. Since the development of *Urechis caupo* has been thoroughly elucidated (Newby, 1940), it is now known that the echiuroids are not more closely related to annelids than to mollusks. Dr. Newby writes at length on a comparison of echiuroid development with that of the other invertebrates and on the phylogenetic position of the Echiuroidea. In conclusion he says (p. 209):

There are many echiuroid characteristics which indicate that this group is separate from the annelids: (a) The mode of development of the first somatoblast is different. (b) The anus is not homologous in the two groups and no proctodaeum is formed in echiuroids. (c) The mesodermal bands do not develop teloblastically in echiuroids. (d) The elongation of the larva is not teloblastic in echiuroids. (e) Three layers of body muscles are formed in echiuroids. (f) The ectomesoderm contributes to the body musculature in echiuroids. (g) A ciliated intestinal groove is formed in echiuroids and this becomes the primordium of the siphon. These structures are not found in the annelids. (h) Anal vesicles, probably of endodermal origin, are found in echiuroids. (i) The coecum of the larval digestive tract becomes a linear part of the adult tract in echiuroids. (j) The mesodermal bands of echiuroids show no evidence of segmentation. (k) The lack of segmentation in the mesoderm considered with the questionable nature of the segmentation of the nervous system and mucous glands and further considered with the "segmentation" of the shell glands of the chitons (molluscs) makes it appear probable that the echiuroids have a primary lack of metamerism.

Against these numerous differences there are only three clear-cut characteristics in common between the echiuroids and annelids which are not also possessed by the mollusks. (a) The annelidan cross develops in both groups. (b) Both groups possess setae. (However setae are to be found in another group of animals [Brachiopoda] which do not belong to the Annelida.) (c) The lateral halves of the nervous system become merged into single, unpaired structures.

With the above facts in mind it is evident that the echiuroids are only distantly related to the annelids. When numerous differences which appear in their development are considered, it seems improbable that the inclusion of the echiuroids with the annelids as a sub-phylum or class, is justified. It is probably more accurate to consider the Echiuroidea as forming a separate phylum, distinct from the phylum Annelida, and I herewith propose that they be so considered.

In the keys no mention is made of *Epithetosoma* Danielssen and Koren, 1881. Théel (1906, p. 9) has demonstrated satisfactorily that the animal is not an echiuroid, but most likely a nemertean.



Neither is *Poeobius meseres* Heath (1930) included. This remarkable pelagic transparent worm was first taken in 350 meters, Monterey Bay, Calif., and was later found to be abundant off southern Alaska. Its anatomy has been fully described by Professor Heath. Subsequently the writer observed and sketched a living animal. The blood vessels are clearly visible and contain a dull green fluid, but the enlargement of the dorsal vessel is dull red. Blood vessels extend to tip of the 2 prostomial palps and the 10 (possibly peristomial) cirri.

The creature has no paired appendages, no somatic segmentation, and no setae. "The nervous system conforms to the usual annelidan type, with supra-oesophageal ganglion, circum-oesophageal connectives, and a ventral nerve chain comprising 11 pairs of ganglia with the usual commissures and connectives. The somatic musculature comprises four great longitudinal bands, extending throughout the length of the body, and a more delicate external sheath of circular fibres." This is the annelid pattern and distinctly not the echiuroid. The head is unlike that of any known echiuroid but resembles that of some polychaete annelids. The alimentary canal and nephridia seem to the writer to be specialized in much the same way as in the case of *Sternaspis*, which in one species (*S. spinosus* Sluiter) has the prostomium prolonged outward on each side to form a grooved palplike organ. The Scoleciformia, however, have definite mesodermal segmentation.

The difficulty in finding a place for *Poeobius* may well mean that it is not an annelid or a echiuroid or a link between the two. Although nothing whatever is known of the development of *Poeobius*, we have to assume that mesodermal segmentation is absent; therefore it is not an annelid. Its nerve cord is segmented (implying pseudometamerism). The nerve cord of larval echiuroids is segmented, but this is lost in the adult, suggesting that the ancestors, while deprived of mesodermal metamerism, still had a pseudometamerism of the nerve cord. A tenable hypothesis is that the echiuroids and *Poeobius* stemmed from a common group that was as fundamentally unsegmented as the *Amphineura* among mollusks. According to this view *Poeobius* is the survivor of a lesser phylum, comparable to the *Phoronidea* and *Priapulidea*. As the genus now floats in a sort of taxonomic limbo, it may be provisionally assigned to a new phylum, POEOBIOIDEA.

The region covered by this report includes all the water north of a line drawn from Cape San Lucas, Baja California, to the southern end of Sakhalin Island on the east Asiatic coast. The Gulf of California has been included, and a species long ago dredged by the *Albatross* in Japanese waters has been added, as it modifies the concept of *Acanthohammingia*, which I wished to include in the key.

The specimens upon which this paper is based have been accumulated slowly over a considerable period of years.<sup>1</sup> In addition, the material belonging to the United States National Museum was placed at my disposal, and an important collection belonging to the Allan Hancock Foundation of the University of Southern California was tendered by Dr. Olga Hartman. The types of all the new species are in the collection of the National Museum.

The following new genus, based on an extralimital species, will be found in the text: *Lissomyema*, type *Thalassema mellita* Conn (under *Listriolobus*).

## Phylum ECHIUROIDEA<sup>2</sup>

Echiuroidea SEDGWICK, 1898, p. 527 (class of Annelida).

Unsegmented, bilateral, fusiform or sacculiform animals with anterior mouth and posterior anus, but no proctodaeum; a long convoluted alimentary canal lying in a spacious coelom of schizocoelous type; a muscular body wall composed of three layers, of which the middle (with one exception) is composed of longitudinal fibers; with one to very numerous anterior nephridia functioning as gonothecae; with typically two anal vesicles having numerous ciliated funnels and functioning as excretory organs; alimentary canal typically with collateral intestine or siphon; usually with a prostomial proboscis, which may exceed length of body but which is sometimes absent; usually with ectodermal setae, of which two, ventrally situated behind mouth, are most constantly present, together with sometimes one or two circles at posterior end of body; but setae absent in a few genera; ventral nerve cord unsegmented forming, around the mouth, a loop which follows border of proboscis; gonad, where known, in mesentery above nerve cord, or in the mesenteries surrounding cloaca.

### KEY TO CLASSES

- a<sup>1</sup>. Body wall with innermost circular or oblique layer of muscles well developed; anal vesicles present; collateral intestine or siphon well developed; proboscis and anterior setae present in nearly all species... **Echiurida** (p. 220)

<sup>1</sup> I am especially beholden to my former colleague Prof. George E. MacGinitie for material of *Urechis caupo*, *Listriolobus pelodes*, and *Ochetostoma octomyotum*; to Edward F. Ricketts for the type of *Echiurus echiurus alaskanus* and a small collection made by him and John Steubeck in the Gulf of California; to Dr. Olga Hartman for a specimen of *Lissomyema mellita*; to Prof. S. F. Light for a perfect specimen of *Listriolobus pelodes*; to the Museum of Comparative Zoology for a specimen of *Urechis chilensis*; to Dr. W. L. Lloyd, Cabrillo Marine Museum, San Pedro, Calif., for the loan of a specimen of *Ochetostoma octomyotum*; to Prof. John H. Gerould for the loan of several rare reprints; and to Dr. Waldo L. Schmitt, U. S. National Museum, for numerous favors.

<sup>2</sup> Echiuroidea was introduced as a subphylum by A. H. Clark (Bull. Inst. Océanogr. Monaco, No. 400, p. 24, 1921) and as a phylum by W. W. Newby (1940, p. 210) and Libbie H. Hyman (1940, pp. 34, 58). As a matter of record, Edward F. Ricketts was the first to use Echiuroidea as a phylum name, in an excellent semipopular text "Between Pacific Tides" (Ricketts and Calvin, 1939, p. 272), perhaps incited thereto by the present writer who has advocated this procedure to his classes for 20 years.

- $\alpha^2$ . Body wall with innermost circular layer missing or degenerated to a net of fibers; no anal vesicles; apparently no siphon; no proboscis and no setae..... **Sactosomatida**<sup>1</sup>

## Class ECHIURIDA

### KEY TO ORDERS

- $\alpha^1$ . In body wall longitudinal muscle layer lying between outer circular layer and inner oblique layer; nephridia, normally paired, not excessively numerous.
- $\beta^1$ . A closed blood-vascular system; no specialization of intestine for anal respiration..... **Echiuroinea** Bock (p. 220)
- $\beta^2$ . No vascular system, coelomic fluid being heavily charged with large blood corpuscles containing hemoglobin or hemoglobin plus hematin; intestine with terminal portion enlarged, thin-walled, to receive water from cloacal pump..... **Xenopneusta**, new order (p. 262)
- $\alpha^2$ . Longitudinal layer of body wall lying outside of both the circular layer and inner oblique layer; nephridia excessively numerous, unpaired (and with terminal nephrostome); proboscis excessively long.  
**Heteromyota**,<sup>4</sup> new order

## Order ECHIUROINEA Bock, emended

A closed blood-vascular system; no specialization of intestine for anal respiration.

### KEY TO FAMILIES

- $\alpha^1$ . Dimorphic; male degenerate, planarianlike, parasitic in or on female; female resembling *Thalassema* but with bifid proboscis in some genera; anal vesicles consisting of branching tubules ending in numerous ciliated cups; anterior setae sometimes present; posterior setae absent..... **Bonelliidae** (p. 249)
- $\alpha^2$ . Not dimorphic; proboscis usually conspicuous, sometimes several times length of body, but never bifid; absent in one genus; anal vesicles not branched but in form of elongate sacs, surface of which is covered with minute ciliated funnels; anterior paired setae present in all genera, posterior setae in *Echiurus* only..... **Echiuridae** (p. 221)

<sup>1</sup> New name for Saccosomatida Théel (1906, p. 14). Théel instituted the group as a suborder for *Saccosoma vitreum* Danielssen and Koren (1881, p. 34, pl. 6, figs. 1-8). This species is based on a single small example dredged in 1,215 fathoms north of the Faroe Islands. It is a female and the species may prove to be dimorphic, as there is a single nephridium filled with eggs and opening near the mouth. The proboscis may have been lost. It is aberrant from all other echiuroids and may not be an echiuroid. *Saccosoma* Danielssen and Koren is preoccupied by *Saccosoma* Motschoulsky, 1859, in Coleoptera (Bull. Acad. St. Pétersbourg, vol. 1, column 304). The new name "Sactosoma" (with identical meaning) is proposed to replace *Saccosoma* Danielssen and Koren.

<sup>4</sup> Based on the remarkable genus *Ikeda* Wharton, 1913, pp. 243-270. Type, *Thalassema taenioides* Ikeda, 1904, p. 63; 1907, p. 16, pl. 1, fig. 3; pl. 2, figs. 18-22; pl. 3, figs. 23-36; pl. 4, figs. 37-47. This large echiuroid, with a proboscis upward of a meter or more in length and nephridia from 200 to 400 in number without indication of paired arrangement, is so different from the general run of the phylum that it deserves to be set apart as the type of at least a distinct order. The arrangement of muscle layers is different from that of all other echiuroids and indicates a long separation from typical stock. See Sato, 1931, p. 179.

## Family ECHIURIDAE (de Blainville, 1827, restricted)

## KEY TO GENERA

- a*<sup>1</sup>. Two circles of posterior setae..... **Echiurus** Guérin-Ménéville (p. 225)
- a*<sup>2</sup>. No posterior setae present.
  - b*<sup>1</sup>. Proboscis absent..... **Arhynchite** Sato (p. 247)
  - b*<sup>2</sup>. Proboscis present.
    - c*<sup>1</sup>. No differentiated thicker bands in longitudinal muscle layer.
      - d*<sup>1</sup>. Nephrostome of nephridia without elongated, spirally coiled lips.  
**Thalassema** Lamarck (p. 230)
      - d*<sup>2</sup>. Nephrostome with elongated, spirally coiled lips.  
**Anelassorhynchus** Annandale (p. 221)
    - c*<sup>2</sup>. Longitudinal muscle layer with very slight to pronounced differentiation into longitudinal bands, 8 or more in number.
      - d*<sup>1</sup>. Nephrostome of nephridia without spirally coiled lips; inner layer of muscles not differentiated into separate transverse fascicles between longitudinal bands..... **Lissomyema**, new genus (p. 224)
      - d*<sup>2</sup>. Nephrostome with elongated spiral lips.
        - e*<sup>1</sup>. Differentiated longitudinal muscle bands weak, zones between not showing a fasciculate arrangement of inner oblique muscles; in small specimens longitudinal bands very faint or visible only in posterior region..... **Listriolobus** W. Fischer (p. 233)
        - e*<sup>2</sup>. Longitudinal muscle bands strongly developed, zones between crossed by separated fascicles of innermost, oblique layer.
          - f*<sup>1</sup>. Nephridia in 1 to 5 pairs; vascular ring vessel at beginning of midgut..... **Ochetostoma** Leuckart and Rüppell (p. 240)
          - f*<sup>2</sup>. Nephridia, at least in male, in 6 to 14 groups of 1 to 4, the groups arranged in pairs; vascular ring vessel at posterior end of pharynx..... **Ikedosoma** Bock (p. 224)

*Remarks.*—In the foregoing synopsis all the generic divisions, with the exception of *Echiurus*, are the result of subdividing the old genus *Thalassema*. In a very real sense these groups are provisional because adequate descriptions and figures of the internal structure of many species have not been published.

**THALASSEMA** Lamarck.—The genus has been restricted to a few species grouped around the type, *Thalassema thalassema* (Pallas), generally known as *Th. neptuni* Gaertner. The middle, longitudinal layer of muscle fibers of body wall shows no sign of differentiation into thicker bands. The internal opening of the nephridia is very simple, without prolongation into spirally coiled lips.

**ANELASSORHYNCHUS** Annandale (1922, p. 148).—It may not be of any practical value to recognize this group. The species differ from *Thalassema* in having the nephrostome lips prolonged and spirally coiled, but little is known of other details of the internal anatomy. Annandale based the genus on the structure of the proboscis of four estuarine species occurring in brackish water of India and Siam. He says:

The genus consists of Echiuridae allied to *Thalassema* Gaertner, but differing in the structure, function, and physiology of the proboscis. This organ is relatively stout and short, incapable of great prolongation or autotomy. The ciliated

groove on its ventral surface is feebly developed and the lateral margins of the ventral surface bear (except in *A. microrhynchus*) gill-like outgrowths. The longitudinal muscle-fibres of the body form a single sheath and the musculature bears a close resemblance to that of some species of *Thalassema*. There are two pairs of nephridia. The anal funnels are simple and thin-walled; their ciliated funnels are minute.

The type-species is *A. branchiorhynchus* (Annandale & Kemp). The other species are *A. dendrorhynchus* (Annandale & Kemp), *A. sabinum* (Lanchester) and *A. microrhynchus* (Prashad).

It seems to me that the modifications of the proboscis, which exhibit a number of gradations in complexity, are adaptations to an ecology in various ways abnormal, a parallel development being found in *Ochetostoma arkati* (Prashad). But these species agree with certain others in having a more specialized nephrostome than is found in *Thalassema thalassema* and close allies.

1. With two pairs of nephridia (behind the setae): *sabinum* Lanchester, *branchiorhynchus* Annandale and Kemp, *dendrorhynchus* Annandale and Kemp, *microrhynchus* Prashad, *semoni* Fischer.

2. With three pairs of nephridia, all three opening behind the setae: *mucosa* Ikeda, *vegrande* Lampert (no proboscis). First pair opening in front of setae: *inanense* Ikeda, *moebii* Greef.

Unless some definite character other than the nephrostome is discovered, there will be a practical difficulty in distinguishing young *Listriolobus*, in which the differentiation of longitudinal muscle bands is very weak.

**LISSOMYEMA.**—Through the kindness of Dr. Olga Hartman I have received a specimen of *Thalassema mellita* Conn collected by her at the type locality, Beaufort, N. C., in June 1940. It is 36 mm. in length, with proboscis 16 mm. additional. From the outside the eight longitudinal muscle bands are clearly visible. Figure 10 represents a dissection of the anterior portion. The muscle bands are much more sharply delimited than in *Listriolobus* by having an incipient fasciculation of the muscles of the oblique layer, possibly representing the first stage in the differentiation of the strong transverse bundles characteristic of *Ochetostoma*. The species has simple fan-shaped nephrostomes and very heavy interbasal and radiating seta muscles. The gizzard is relatively short and the stomach (*C*) is relatively long. An individual variation is the presence of three nephridia on one side and two on the other. The species is described

FIGURE 10.—*Lissomyema mellita* (Conn): Dissection of anterior region of a specimen from Beaufort, N. C.,  $\times 12$ . Six of the eight muscle bands are diagrammatically indicated by dots. The alimentary canal is drawn to the right to disclose the organs beneath it. (*B*<sup>1</sup>, *B*<sup>2</sup>, *B*<sup>3</sup>, dorsal, neurointestinal, and ventral blood vessels; *C*, stomach; *G*, gizzard; *I*, intestine; *MD*, middorsal muscle band; *MI*, interbasal muscle; *MP*, midventral muscle band; *N*, nephridia; *NC*, nerve cord; *O*, esophagus; *P*, pharynx; *S*, seta; *Stl*, beginning of siphon.)

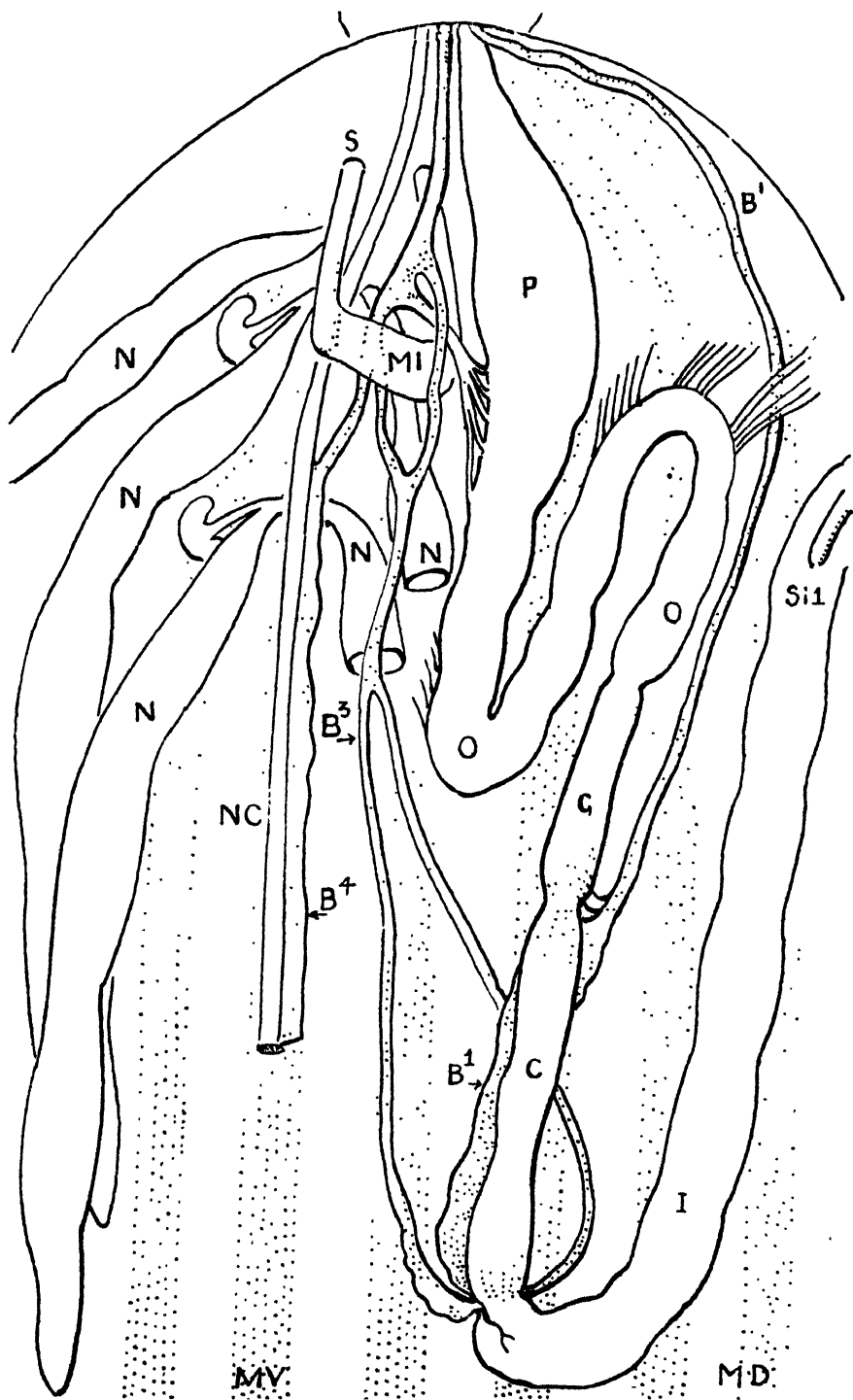


FIGURE 10.—(See opposite page for legend).

as having two pairs. The anal vesicles are voluminous with numerous conspicuous ciliated funnels. The ventral blood vessel sends an important branch to the pharynx and esophagus.

For this species, therefore, I propose the new genus *Lissomyema*, which differs from *Thalassema* in having eight well-differentiated longitudinal muscle bands and incipient fasciculation of the oblique layer; from *Listriolobus* and *Ochetostoma* in having simple fan-shaped nephrostome without trace of spiral extensions. Type, *Thalassema mellita* Conn. (Fig. 10.)

IKEDOSOMA Bock.—*Thalassema elegans* Ikeda<sup>5</sup> does not belong in *Thalassema*. Ikeda (1907, p. 50) writes: "All the longitudinal lines visible on the outside, excepting the one which runs in the mid-ventral line and is superposed by the nerve-cord, appear on the inner surface of the body-wall as slightly elevated narrow ridges or thickenings of the longitudinal muscular layer. In the ten zones separated from one another by the above lines, the circular muscle fibres form more or less regularly arranged transverse bundles." This structure of the body wall closely approximates that of *Ochetostoma*, but *elegans* is peculiar in having numerous (13 to 27) nephridia in six or seven pairs of groups comprising one to three nephridia each. "The internal opening present at base is provided with 2 relatively short spiral lobes." The dorsal blood vessel ends with the "heart" on the hind end of the pharynx and is therefore shorter than in typical Echiuridae. "The neuro-intestinal vessel arises from the ventral median point of the ring-sinus, which surrounds the extreme hind end of pharynx" (*ibid.*, p. 52). There is no interbasal muscle and no intestinal coecum.

*Thalassema gogoshimense* Ikeda (1904, p. 66, pl. 1, fig. 19) is apparently congeneric with *elegans*. The excellent colored figure shows the same white longitudinal stripes as *elegans*, reflecting the muscular structure of body wall. Ikeda says: "It shows an essential agreement with *Thalassema elegans*. Indeed, the agreement may be said to be complete, the only difference being that all the visceral organs in the present species are developed on a smaller scale in proportion to the smaller size of its body." In the females, however, the nephridia are present in three pairs all situated behind the setae, while in the male they are in six to eight groups, arranged in pairs, each group with one to four nephridia, which are like those of *elegans* in structure.

The above paragraphs were written and a name was assigned to the genus before I saw Bock's paper. They are retained since we independently arrived at the same conclusion.

<sup>5</sup> Ikeda, 1904, p. 65; 1907, p. 47, pl. 1, fig. 4; pl. 4, figs. 48, 49; Sato, 1939, p. 356; Bock, 1942, p. 18.

## Genus ECHIURUS Guérin-Ménéville

*Echiurus* GUÉRIN-MÉNEVILLE, 1831, p. 9, pl. 6, fig. 3 (ex Shipley, 1899, p. 342) (type, *Lumbricus echiurus* Pallas, 1766 = *Echiurus pallasi* Guérin-Ménéville, 1831).—SKORIKOV, 1909, p. 80.—SPENGEL, 1912b, p. 173.

Echiuridae with two rings of posterior bristles, a well-developed proboscis, two or four nephridia (without spirally coiled lips), and a postpharyngeal diaphragm, which separates incompletely the small head coelom from the perivisceral cavity.

## ECHIURUS ECHIURUS ALASKANUS, new subspecies

## PLATE 20

*Echiurus Pallasi* C. B. WILSON, 1900, p. 174.

*Echiurus echiurus* SPENGEL, 1912b, p. 183.

*Diagnosis.*—Differing from typical *E. echiurus* (Pallas) of the north Atlantic and neighboring Arctic Ocean in having the proboscis strongly attached to the body and in having the posterior setae definitely curved rather than nearly straight. Length of type, 230 mm. plus much contracted proboscis, 20 mm.

*Description.*—Length of body upward of 230 mm., commonly 100 mm., stout; proboscis adherent, fleshy, convex above, the edge incurved ventrally, subtruncate distally, usually 15 to 20 mm. long in contracted state. On ventral surface of the proboscis a differentiated thickening extends as a low ridge from the mouth for about one-fourth length of proboscis but sometimes considerably farther. The integument is roughened by rings of prominent verrucae most crowded at ends of body. In the middle region, where they are generally less crowded, rings of more prominent verrucae alternate with zones of three to five rings in which the verrucae are smaller or more widely spaced, or both. The appearance depends largely upon the degree of contraction of the body muscles.

The anterior setae are stout, strongly curved, and situated back of the base of proboscis a distance equal to about its greatest width. In each circle of anal bristles there may be variations of 6 to 8, as: 8-8 (posterior ring); 8-7; 8-6; 7-7; 7-6. In some specimens where the number is less, inequality of spacing indicates loss of setae. These posterior setae vary in degree of curvature but are slightly more curved than in typical *E. echiurus*. The anterior setae have a strong interbasal muscle connecting their inner ends. Occasionally a second seta, in process of formation, accompanies one of the primary. The principal posterior muscle from the setae attaches to body wall just behind the anterior nephridium.

The inner circular layer of body muscle shows a division into closely placed fascicles at each end of body, where the animal is normally most contracted.



Nephridia 4, the anterior pair close behind the setae and a little farther from nerve cord. The funnel is conspicuous, with an undulating or frilled border, but is not prolonged into spiral lips. The nephridia of all specimens examined (taken in summer months) were contracted. In some cases they were very small, and the anterior pair very inconspicuous.

Anal vesicles are simple, elongate, thin-walled sacs attached to ventrolateral wall of the cloaca and closely beset with minute ciliated funnels.

DIAPHRAGM (pl. 20, figs. 1, 4). The diaphragm is a curious, thin-walled, funnel-shaped septum incompletely separating the peripharyngeal coelom from the general body cavity. Its general form is best appreciated from the figure in which it is shown in a semidiagrammatic fashion. The anterior, roughly circular edge is completely attached to the body wall, while ventrally it is attached to body wall on each side of the nerve cord (which here lies within the ventral mesentery of pharynx and esophagus). A large oblique posterodorsal opening of the diaphragm (with complete free edge) allows the esophagus (with its strong ventral mesentery) to pass backward into the general coelom, sometimes above and sometimes below the interbasal muscle. The rim of aperture apparently has a sphincter. The two halves of the double ventral mesentery of esophagus merge with diaphragm along its paraneural part and a short distance above the nerve (pl. 20, fig. 5).

ALIMENTARY CANAL. The pharynx remains always in the peripharyngeal coelom. It is attached to the body wall by numerous strong muscular strands having an annular arrangement. There is a continuation forward of the double ventral and dorsal mesenteries separated into frenula. The dorsal blood vessel lies in this mesenterial complex. The head cavity is therefore much occluded by tissue. The lining of pharynx is anteriorly thrown into coarse folds.

The esophagus begins just behind the region of the radiating frenula of pharynx. It has, in the anterior portion, a dorsal mesentery of slender separate strands, but there is a double membranous ventral mesentery throughout its whole extent. This mesentery is anchored in the peripharyngeal chamber on each side of the nerve cord, where, a short distance above body wall, it merges with the diaphragm. By means of its muscular mesenteries, all of the esophagus can be withdrawn into the head cavity.

The esophagus, on passing *through* the right side of the diaphragm close to posterior border, becomes a long gizzard, marked by rings, which are prominent annular ridges of the lining. Beginning with the gizzard the alimentary canal is moored only by dorsal mesenterial ribbons as far as the cloaca, which has radiating muscular frenula. Along the dorsal side of the gizzard held by a perforated mesentery

is the voluminous dorsal blood vessel with numerous papilliform branches, at least anteriorly.

A very short rudimentary stomach or crop lies between the gizzard and beginning of intestine (indicated by the ventral ciliated groove). The lining of stomach is thrown into 12 strong longitudinal folds, contrasting sharply with the annular folds of gizzard. Where the stomach becomes intestine, the dorsal blood vessel splits to form the ring vessel.

The intestine has the usual three parts: presiphonal, siphonal, and postsiphonal. The first is about as long as the gizzard, or a little longer if relaxed.

The siphonal part, roughly 20 to 25 times length of presiphonal part, is marked by longitudinal folds of the lining which are evident superficially. The siphon is about one-fourth the diameter of the intestines.

The postsiphonal intestine has thinner walls and is about 10 times the length of presiphonal segment. The ciliated groove forms a ridge along its ventral side, and ends at a coecum (not always inflated) just in front of the cloaca. The fecal pellets which fill this part of the intestine are elongate ellipsoids and sometimes contain coarse material. I have found leaves of the hemlock (*Tsuga*).

**VASCULAR SYSTEM.** This consists of a dorsal and ventral blood vessel and neurointestinal connective. These vary in caliber in different specimens. The dorsal vessel is likely to be considerably inflated over part or the entire length of gizzard, with irregular lobose swellings anteriorly. The ventral vessel, attached to middorsal line of nerve cord, ends posteriorly as a solid cord just in front of the intestinal coecum. The neurointestinal connective results from the branching of the dorsal vessel at the beginning of intestine by which the neurointestinal ring ( $B^2$ ) is formed. The connective branches again ( $B^3$ ), to form the muscle ring, before merging broadly with the ventral vessel ( $B^4$ ).

*Type*.—U.S.N.M. No. 20609.

*Type locality*.—Auk Bay, Juneau, Alaska, collected by E. F. Ricketts, August 14, 1931.

*Specimens examined*.—One hundred and twenty-four as follows:

#### COLLECTION OF STANFORD UNIVERSITY

Kukak Bay, Shelikof Strait, Alaska, 12 specimens, under rocks, in mud; McMillan, 1924.

Wrangell, Alaska, 37 specimens; A. W. Greely and R. E. Snodgrass, 1897.

Auk Bay, near Juneau, Alaska, 3 specimens, slate beach, under rocks, in muddy sand, lowest intertidal zone, July 17, 1931; E. F. Ricketts (also type from this locality, August 14, 1931).

Huston Inlet, Queen Charlotte Islands, British Columbia, 42 specimens; W. F. Thompson, July 1, 1913.

Alaska, possibly Dutch Harbor, Unalaska, 5 specimens.

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Cape Smyth, Alaska, 3 fathoms, No. 850, Point Barrow Expedition; 2 specimens in very bad condition, without proboscis; possibly these are intermediate with true *echiurus*.

Off Cape Stroganof, Alaska, *Albatross* station 3291, lat. 56°58'30" N., long. 159°11' W., 26 fathoms, black sand, gravel, 1 specimen from stomach of cod, in poor condition.

Bristol Bay, Alaska, No. 4597, 2 specimens, one lacking proboscis.

Unalaska, Alaska, No. 16314, 2 specimens.

Bering Island, Nos. 4151, 16315, 2 specimens, typical.

Alitak Bay (head of Lazy Bay), Kodiak Island, gravelly sand, January 22, 1941, 5 specimens.

Stepovak Bay, Alaska, 15-90 fathoms, October 24, 1940, 1 specimen.

-Dolgoi Harbor, Alaska, October 6, 1940, 1 specimen.

Wrangell, Alaska, No. 4538, August 28, 1882, under stones, 2 specimens.

Chasina Bay, Alaska, No. 4601, 1 specimen.

Saginaw Bay, Alaska, No. 4117, 1 specimen.

Without stated locality (probably Unalaska), 5 specimens.

*Remarks.*—The type specimen was taken from its burrow, a tube in sandy clay beach, 24 inches below the surface, along with a commensal polynoid annelid, *Hesperonoë adventor* (determined by Dr. Olga Hartman). The same species is commensal with *Urechis caupo*.

This, the common Alaskan *Echiurus*, differs from the typical form of Europe and the north Atlantic coast of America in having the proboscis firmly attached to the body. All writers who have handled living *Echiurus echiurus* emphasize its habit of dropping the proboscis on the slightest provocation.<sup>6</sup> Most of the 120 specimens of *alaskanus* were not handled with care but were simply dropped into alcohol; 106 of these specimens still have the proboscis firmly attached, while at least 5 lost the proboscis subsequent to fixing, apparently from rough handling.

Under ordinary circumstances I should have given Brandt's name *sitkaensis* to this form, assuming that Mertens would naturally have picked up at Sitka the common Alaskan species. J. W. Spengel (1912b), however, succeeded in obtaining one of Mertens's two specimens, upon which Brandt based his description, and found that it differed fundamentally from *Echiurus echiurus* in having only two nephridia, as well as in certain other respects. The name *sitkaensis* is therefore definitely associated with a type specimen which has been redescribed by one of the best zoologists of his time.

The ecology of *Echiurus echiurus* has been studied by Dr. Torsten Gislén (1940) chiefly at Kristineberg, Sweden. His very compre-

<sup>6</sup> Torsten Gislén says: "As stated before the proboscis is very easily thrown off. In fact probably only very few men have seen a proboscis in connection with an *Echiurus*. Forbes and Goodair say that it is so slightly affixed to the body as to break off at the least touch; in only one or two cases did they find it attached, and then it broke away immediately on the removal of the animal. Only in some exceptional instances have I been able to secure specimens with the proboscis retained." (Gislén, 1940, p. 10.)

hensive memoir is in the forefront of excellence and will long serve as a model for this type of work.

ECHIURUS SITKAENSIS (Brandt)

*Thalassema (Echiurus) sitkaensis* BRANDT, 1835, p. 62.

*Echiurus sitkaensis* SPENGEL, 1912b, pp. 184–189.

*Diagnosis.*—Corpus circiter tripollicare oblongum, e subbrunneo olivaceum, obscurius punctatum et transversim striatum. Proboscis latiuscula, carnea, transversim purpureo striata, apice emarginata. Unguiculi anterioris corporis partis et spiculae posterioris lutea. (Brandt.)

Differing from *E. echiurus* in having two nephridia, in lacking a differentiated ridge of tissue along ventral side of proboscis, and in having skin papillae subequal rather than in rings of larger papillae alternating with narrow zones of smaller.

*Remarks.*—This species constitutes one of the major mysteries in the systematics of the Echiuroidea. Mertens collected two specimens at Sitka, both of which he dissected. One of these specimens, his notes on the dissections, and a life sketch in color reached the St. Petersburg Museum and were used by Brandt. Subsequently all these became available to Spengel, as he details in his *Echiurus* paper (1912b).

Spengel made a thorough examination of what remained of the internal anatomy and was able to satisfy himself that *only two nephridia were present*, in the location of the anterior nephridia of *E. echiurus*. The proboscis was very adherent to the body, and it lacked the ridge of tissue on its concave under surface. As less important differences he lists: skin papillae subequal, in rather regular and very numerous rings (not rings of larger papillae alternating with zones of smaller); curvature of anal setae stronger than in *echiurus*; color, according to Mertens's drawing, brownish olive spotted and cross-striped with darker, the proboscis flesh color with purple transverse stripes.

The tough, nondeciduous proboscis is characteristic of the Alaskan *Echiurus* I have examined, but all these have the ventral ridge present, leaving as the principal characters of *sitkaensis* the two nephridia, absence of proboscis ridge, and the subequal papillae.

Wilson (1900, p. 174) states that he examined Alaskan specimens of *E. echiurus* (= *alaskanus*) collected by Dr. W. R. Coe in 1899. "This species was found abundantly at many different localities along the Alaskan coast south of the Peninsula and on adjacent islands, nearly always in rich black mud." I have listed 120 specimens from Alaska and British Columbia. None of these is *sitkaensis*.

If there is a species *sitkaensis* it may normally live below low tide and only occasionally be carried shoreward during heavy storms.

*Type*.—Formerly in St. Petersburg Museum; collected by H. Mertens.

*Type locality*.—Sitka, Alaska.

### Genus THALASSEMA Lamarck

*Thalassema* LAMARCK, 1801, p. 328 (type, *Lumbricus thalassema* <sup>1</sup> Pallas, 1771, *Spicilegia Zoologica*, fasc. 10, p. 8, pl. 1, fig. 6).

*Diagnosis*.—Echiuridae with a well-developed proboscis but without anal bristles and without specialized bands in the longitudinal layer of body muscles; inner oblique layer smooth, except sometimes for a short distance at anterior end of body; anterior nephridia (gonothecae) one or two pairs, the internal ciliated funnel (nephrostome) without spiral lobes.<sup>8</sup>

THALASSEMA STEINBECKI, new species

### FIGURE 11

*Diagnosis*.—Small, slightly translucent, the proboscis as long as body, broad proximally, ribbonlike distally; nephridia, two pairs, the ciliated funnel with simple subcircular opening lacking any trace of spiral lips; interbasal muscle of setae well developed, strong, passing through loop of dorsoventral blood vessel; siphon beginning a short distance from vascular ring; precloacal intestinal cecum; intestinal mesenteries including conspicuous subfusiform fleshy masses; anal vesicles as long as contracted body, covered with numerous tiny ciliated funnels. Length of body 12 mm.; of proboscis, 12 mm.

*Description*.—The skin is coarsely verrucose for a short distance back of proboscis and on terminal third of body; elsewhere the verrucae

<sup>1</sup> *Thalassema* was first used in a generic sense by Lamarck. Although Pallas (*Spicilegia*, 1771) mentions the name *Thalassema* as used by Joseph Gaertner, he names the animal *Lumbricus thalassema*, which appears to be the first valid binomial referring to the species generally known as *Thalassema neptuni* Gaertner. The latter is in effect a manuscript name. Neither Shipley (1899, p. 351) nor Wharton (1913, p. 265), who have offered revisions of *Thalassema*, gives any reference for the combination *Thalassema neptuni*. Quatrefages (1865, vol. 2, p. 595) cites "*Thalassema Neptuni* Gaertner, cité par Pallas, *Spicilegia Zoologica*, fasc. 10, p. 8, pl. 1, fig. 6." Forbes, 1841, in his "History of British Starfishes and Other Animals of the Class Echinodermata," gives a good account of the habits of "Gaertner's spoon-worm, *Thalassema Neptuni* Gaertner." The first item in his list of references is *Lumbricus Thalassema* Pallas.

The derivation of the word seems to be *thalassos* (sea) + *ema* (dart).

<sup>8</sup> Shipley (1899, p. 351) in his revision of *Thalassema* is in error in the statement that the nephridia have their internal openings spirally twisted. Lankester (1881, p. 355) writes that they are semicircular and contrasts them with the spiral sort found in *T. moebii*, as figured in Greef's "Die Echiuren" (1879, pl. 8, fig. 69).

FIGURE 11.—*Thalassema steinbecki*, new species: A, The type,  $\times 14$ , showing arrangement of organs; the greater part of the intestine has been omitted and the foregut has been strongly bent to right in order to uncover the nephridia. B, A seta,  $\times 20$ , from a specimen taken in 165 fathoms off San Francisco Bay, Baja California; above, the hook, further enlarged. C, Ventral view of the type,  $\times 4$ . (AV, Anal vesicle; B<sup>1</sup>–B<sup>4</sup>, dorsal, ring, neuro-intestinal, and ventral vessels; C, stomach; CG, ciliated furrow of intestine; Cl, cloaca; G, gizzard; I, intestine; IC, intestinal cecum; Me, mesenterial bodies; MI, interbasal muscle of setae; N, nephridia; NC, nerve cord; O, esophagus; P, pharynx; S, seta; Si1, anterior end of siphon.)

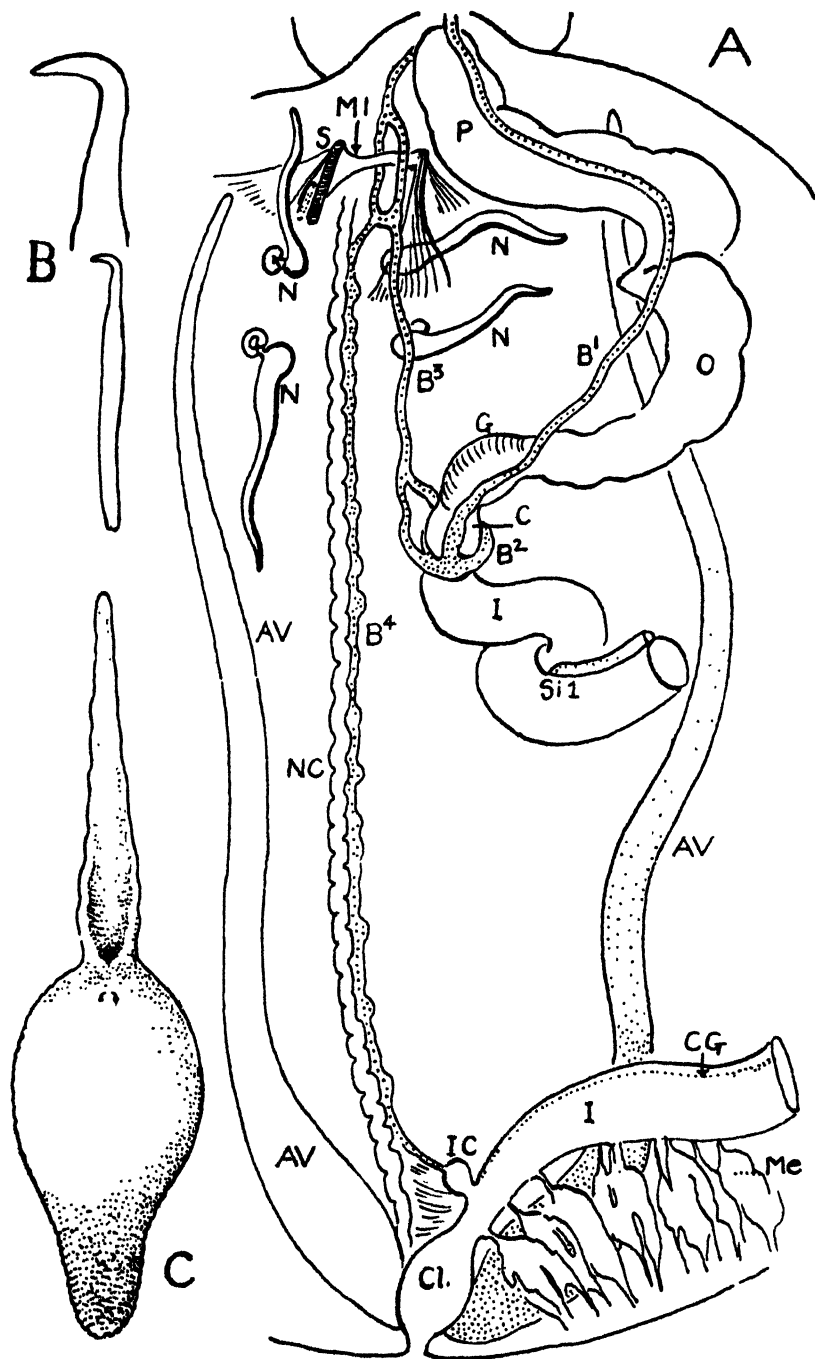


FIGURE 11.—(See opposite page for legend).

are obviously smaller, and there is a suggestion of transverse alignment. The appearance of the skin will depend a good deal on the state of contraction of body wall. The middle portion of body is slightly translucent, not transparent in places as in *Listriolobus pelodes*.

The setae have a stout interbasal muscle connecting the inner ends, from which radiate numerous fan-shaped sheets of muscle which attach broadly to the body wall. A posterior muscle passes over the first nephridium and merges with the body wall between the first and second nephridia. Setae 1.8 mm. long with a small hook, the point of which is at right angles to the shaft. In the type and a number of other specimens the hook is worn off.

Inner layer of muscles of body wall smooth except in front of anterior nephridia where there is differentiation into about a dozen bundles passing around the body. The middle layer is undifferentiated as in other species of the restricted genus *Thalassema*.

The four nephridia are small in the type, which is probably a male. In the specimen from station 2828 they are enormously inflated and full of eggs. In the type the ciliated funnel is very simple, with smooth lips forming an incomplete circle. In the female the funnel is flattened and pear-shaped and somewhat distorted by pressure, but there is no indication of elongation into spirals.

The deflated anal vesicles are as long as the body and have the appearance of being capable of inflation to a great size.

The alimentary canal is moderately long but conspicuously shorter than that of *Listriolobus pelodes*. The contents are not always formed into pellets. The foregut consists of a pharynx-esophagus, midway along which is a sharp bend. Both the gizzard and stomach are unusually short. The former is marked by ring striations. At the posterior end of the stomach is the ring blood vessel ( $B^2$ ) marking the beginning of the intestine, on the lower side of which is the ciliated groove. At a distance back of the ring vessel equal to about length of gizzard and stomach the siphon begins and runs for about half length of intestine. The ciliated groove continues to the intestinal coecum in front of the cloaca. The pharynx has a conspicuous ventral mesentery, and all along the canal are numerous dorsal mesenterial strands. Posterior to the region of the siphon the mesenteries inclose, or hold, conspicuous yellowish-white masses, sometimes subfusiform or in irregular sheets, which remind one of the suet found in mammals. A squeeze reveals several sorts of cells, some of which may be immature sperm. The cloaca is small and thin-walled.

The vascular system consists of the dorsal vessel ending posteriorly in the ring vessel, from which the neurointestinal connective passes to the ventral vessel, forming a loop enclosing the interbasal muscle of setae. The ventral vessel ends posteriorly at the intestinal coecum. In the female from station 2828 the vessels are the same.

*Type*.—U.S.N.M. No. 20600.

*Type locality*.—El Mogote, near La Paz, Baja California, low tide, March 22, 1940, 1 specimen, Steinbeck and Ricketts.

*Specimens examined*.—Eight as follows:

Albatross station 2828, Gulf of California, 24° 11' 30'' N., 109° 55' W., 10 fathoms, shells, 1 specimen.

La Plata Island, Ecuador, 7–10 fathoms, rocky with nullipores, 2 specimens, Allan Hancock Foundation.

Thurloe Bay, Baja California, 8–10 fathoms, rock with gorgonids, 1 specimen, Allan Hancock Foundation.

Off San Francisquito Bay, Baja California, 165 fathoms, shale and gray mud, 1 specimen, Allan Hancock Foundation.

Ensenada de San Francisco, Baja California, 2–6 fathoms, 1 specimen, Allan Hancock Foundation.

Agua Verde Bay, Baja California, 10 fathoms, mud and coral, 1 specimen, Allan Hancock Foundation.

Dewey Channel, San Eugene Point, Mexico, 21–24 fathoms, coralline, rock, 1 specimen, Allan Hancock Foundation.

*Distribution*.—Baja California to Ecuador, low tide to 165 fathoms.

*Remarks*.—Mr. Ricketts states that the type was associated with living *Dentalium* in sandy mud a short distance below the surface. The specimen from station 2828 has the intestine filled with small fragments of shells.

As this species belongs in the restricted genus *Thalassema*, it naturally resembles *Th. thalassema*. The gizzard, stomach, and presiphonal intestine are definitely longer in the latter species and the anal vesicles smaller, although with such extensible structures it is difficult to make comparisons. It may be recorded that in alcoholic specimens there is no division of the body into three parts, which Leigh-Sharpe (1928, p. 501) reports as a characteristic of *thalassema*. The ecology of the two species is very different. Lankester (1881, p. 350) found *thalassema* on the south coast of Devonshire "in galleries excavated in the red sandstone (not limestone) which is exposed at spring tides. The galleries appear to be those formed by the Lamellibranch *Gastrochaena* which the *Thalassema* appropriates." Leigh-Sharpe (1928, p. 499) reports the species from borings in limestone made by the mollusk *Saricava*, Plymouth Sound.

Named for John Steinbeck, whose expedition to the Gulf of California collected the type.

#### Genus LISTRIOLOBUS W. Fischer

*Listriolobus* SPENGEL, 1912c, p. 316 (*nomen nudum*).—W. FISCHER, 1926a, p. 210 (no type). (Type, *Listriolobus bahamensis* Fischer.)

*Diagnosis*.—Differing from *Thalassema*, sensu stricto, in having elongate, spirally coiled lips to nephrostome and 8 to 16 narrow meridional thickenings of the middle, longitudinal muscle layer. Differing from *Ochetostoma* in having the inner oblique layer a smooth con-



tinuous sheet between the longitudinal bands, not divided into separate fascicles. Nephridia 2 or 3 pairs; interbasal muscle of setae present.

The character of the longitudinal muscles is not well marked in *L. pelodes* until the animal has reached a length of 15 to 20 mm. and after it is sexually mature. Apparently in *L. sorbillans* (Lampert) a similar condition exists (Wharton, 1913). Even so, the structure of the nephrostome will segregate these species from true *Thalassema*. *L. riukiensis* (Sato, 1939, p. 359, figs. 10-13) is probably not a *Listriolobus*. There is no interbasal muscle to setae; the diagram of the blood vessels is not the *Listriolobus* pattern.

Spengel (1912c, p. 316) established *Listriolobus* for *Thalassema erythrogrammon* of Sluiter (1883) and of Wilson (1900). Sluiter's species came from Billiton in the Java Sea while Wilson's was taken in the Bahamas. Spengel had Sluiter's animal and a duplicate, from Florida, of Wilson's species, which he characterized as "nearly related." Unfortunately, as neither of these species had a valid name, *Listriolobus* was without a type and was technically a nomen nudum. Spengel did mention *Thalassema mellita* Conn as a *species inquirenda*, "which species one must include in the above genus I can not at present decide, nor even whether or not it is justifiable to include such a form as *Th. mellita*, which has bundles of longitudinal muscles that arise from thickenings of the continuous longitudinal muscle layer." A few lines farther on he says: "The animals described by Sluiter and Wilson as *Thalassema* should be put in the same genus with *Th. mellita* because of the nature of the sheaths surrounding the tunic muscles. I propose the generic name *Listriolobus* for the species of Sluiter and Wilson."

Wilhelm Fischer (1926a, p. 110) discusses *Listriolobus* and names Wilson's and Sluiter's species *Listriolobus bahamensis* and *L. billitonensis*. So far as I know this is the first association of *Listriolobus* with a species from which a type can be chosen. Since Fischer did not do this I will so designate *Listriolobus bahamensis* Fischer, as being the species more likely to be available for study in the future. By implication Fischer includes *Th. mellita* Conn in *Listriolobus*, but I have made it the type of a new genus, *Lissomyema*.

#### **LISTRIOLOBUS PELODES, new species**

FIGURES 12, 13; PLATE 21, FIGURES 1, 2, 4, 4a, 4b; PLATE 22

*Description*.—Largest specimens 40-60 mm. long and 12-25 mm. thick; proboscis capable of extension to slightly exceeding length of body, narrow, thin, translucent, so that nerve loop is visible.

Body wall translucent, marked by eight narrow longitudinal muscular thickenings which appear light gray against the darker and much broader areas between them. There are a middorsal and midventral

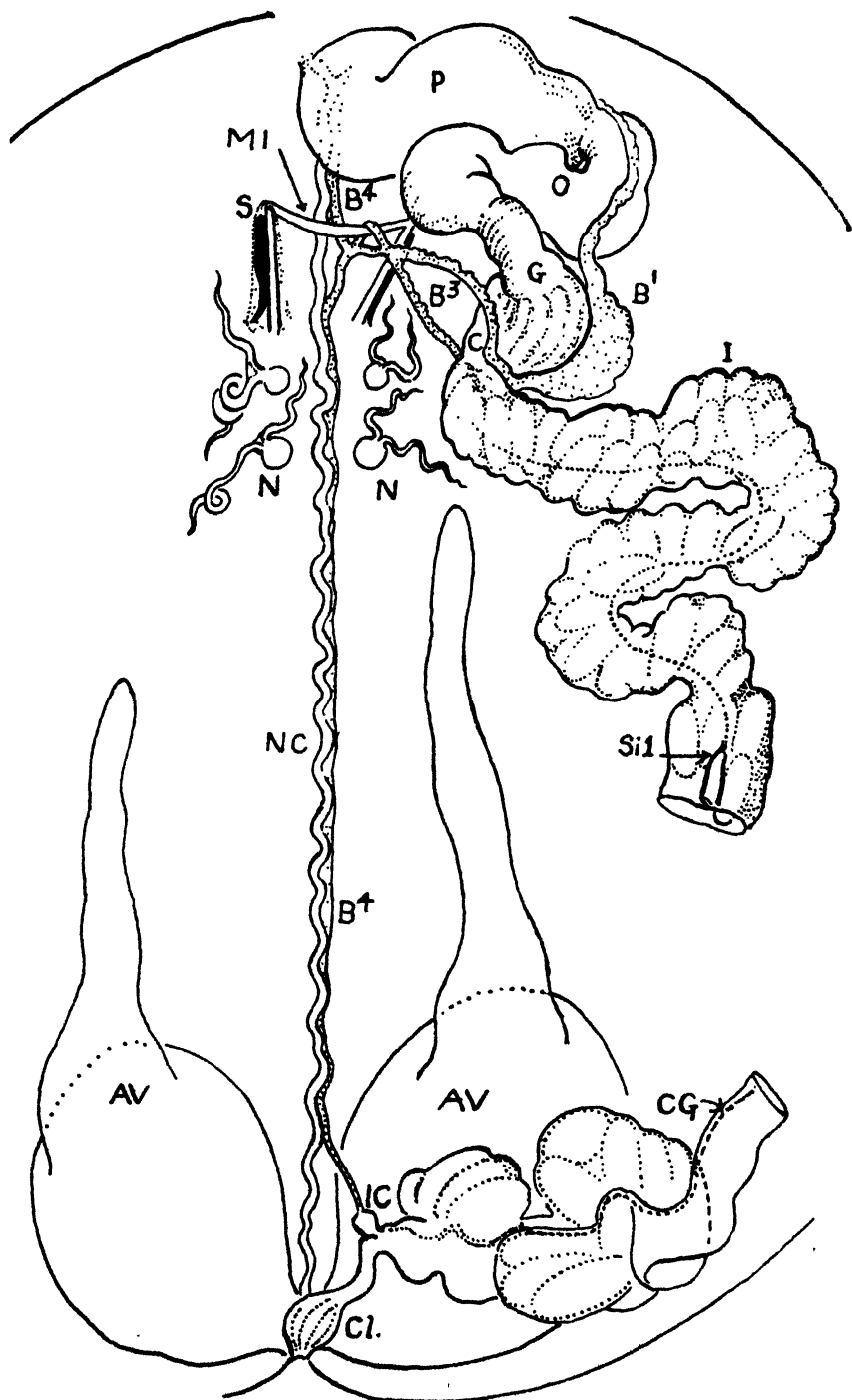


FIGURE 12.—*Listriolobus pelodes*, new species: Small specimen,  $\times 15$ , showing arrangement of organs. The greater part of the intestine has been removed. In this specimen the nephridia are very small. Lettering as in figure 11.

band and three lateral, equidistantly spaced. The bands, 1.5 to 2 mm. broad, represent concentrations of longitudinal muscle fibers, which gradually thin out on the sides of the bands. The skin is beset with small, unequal, subcircular and elliptical glandular thickenings arranged in transverse close-set lines. At posterior end there is an area of greatly enlarged papillae. Coelomic surface of body wall smooth; innermost layer of slightly oblique muscle fibers very thin, uniform, not interrupted by the longitudinal thickenings of the middle layer.

Setae 2, close together, and close to the mouth. Sometimes two setae occupy one of the sheaths, with a single normal one in the other. There is an interbasal muscle uniting top of the sheaths. This passes through a loop in the dorsoventral blood vessel.

Nephridia 4, variable in size. In the type the anterior pair is smaller than the posterior, but in another specimen the anterior pair is the larger and the four are about five times the length of those of type. They have the same terminal slender portion, which can undoubtedly be expanded. Both specimens are males. The anterior pair is situated posterior to setae about the length of the latter. The ciliated funnel has long coiled lips and is attached to the outer side of the base of nephridium by a short stalk. In a third specimen the nephridia are empty and reduced to filaments slightly expanded at base. In a full-grown female (Tomaes Bay) the nephridia are 20 mm. long, slender, and contain numerous eggs (June 7), 0.08 to 0.09 mm. in diameter.

Anal vesicles 2, variable in size, capable of great extension. Each is fastened to body wall about 5 mm. laterally from the anus by one or two mesenteries and ventrally by another pair close to nerve. Into these, which appear hollow, extends a short diverticulum of the vesicle. There are scattered, very tiny, ciliated funnels. The well-preserved female from Tomaes Bay has vesicles that extend as far forward as the large posterior nephridia and lack the basal diverticulum found in the male.

**ALIMENTARY CANAL.** The pharynx extends to the sharp bend shown in the illustration, followed by the esophagus. The gizzard is short and the stomach relatively long, but there is bound to be variation in different specimens owing to the accidents of preservation. The intestine proper starts just back of the ring blood vessel, at the beginning of the ciliated groove, which soon becomes differentiated into the siphon. Even in the carefully hardened specimen from Tomaes Bay the intestinal wall is delicate and transparent. The length is difficult to measure on account of unequal contraction. The siphonal part is on the order of 100 mm. in length and the postsiphonal 125 mm. (length of specimen, 40 mm.). Throughout its length the intestine is stuffed with small unequal (1-2 mm.) ellipsoidal mud pel-

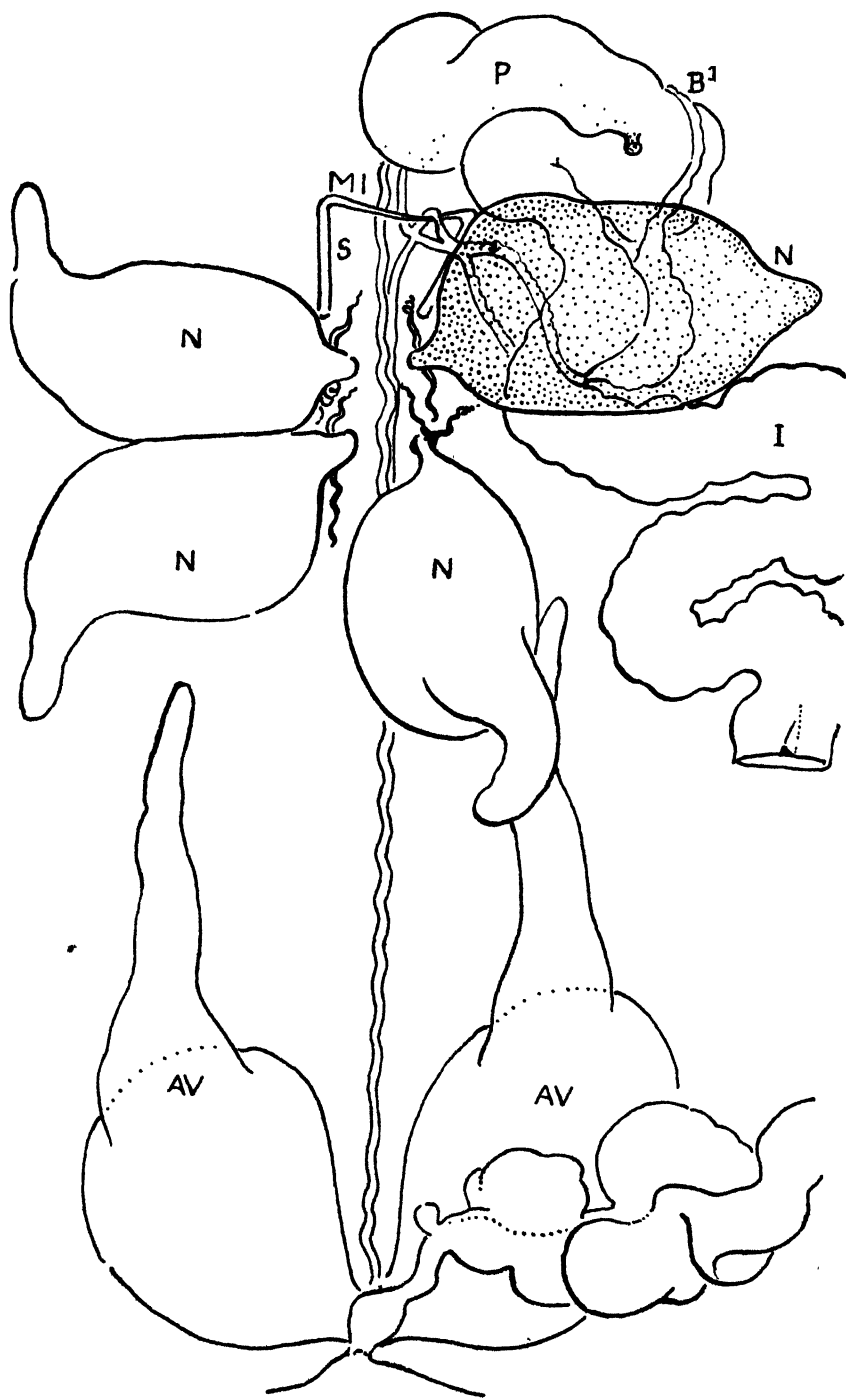


FIGURE 13.—*Listriolobus pelodes*, new species: A sexually mature but small female, showing nephridia greatly swollen by contained eggs (not indicated),  $\times 15$ . Lettering as in figure 11.

lets. Just before the hind-gut passes into the small cloaca there is a spherical ventral coecum, to which extends the ventral blood vessel.

The vascular system can be readily followed on plate 22. The neurointestinal connective forms a loop around the interbasal muscle of the setae. The two flaplike expansions of this vessel, shown in the figure, are not present in the Tomales Bay specimen. The dorsal vessel varies widely in diameter being sometimes greatly inflated (Tomales Bay), the inflation extending into the neurointestinal connective.

Owing to the very thin, translucent body wall the nerves can sometimes be seen under strong illumination such as sunlight. They pass directly around the body, from the ventral nerve cord, without visible branches. The translucent proboscis affords an opportunity to trace the proboscis loop throughout its entire course (pl. 21, fig. 2). This ganglionic continuation of the ventral cord is near the margin of the proboscis, to which numerous tiny nerves pass from slight ganglionic thickenings on the outer side of the cord. No nerves, under favorable conditions, could be detected on the mesial side of the cord.

Color in life: "Proboscis yellow orange, deepest on edge; body dull grey-violet with greenish raised specks about 0.5 mm. in diameter, spaced quite regularly about 0.5 mm. apart (the papillae); 8 lighter colored muscle bands" (large specimen from Tomales Bay).

**SMALL PHASE** (figs. 12, 13; pl. 21, figs. 4, 4a-b). Small examples are fairly common on muddy bottom in moderate depths off southern California and in Newport Bay. These preserve badly unless special care is exercised. They are usually strongly contracted into subspherical form and vary greatly in appearance. Sometimes the body wall is rather uniformly transparent but more often the posterior portion is opaque. This region may be smooth or thrown into eight meridional swellings which occasionally extend the whole length, giving the appearance of a tiny melon. These swellings are caused by the contraction of the eight muscle bands and are found in strongly contracted specimens 7 mm. long. But specimens in which the body wall is stretched and transparent do not show indications of differentiated muscle bands until much later—at a length of about 15 to 20 mm. In the very small sizes the muscles are likely to show first posteriorly and ventrally. A specimen 20 mm. long from 55 fathoms off Santa Cruz Island has the 8 bands fully developed. Even in large specimens (40 mm.) the bands are not always equally conspicuous.

I have found a specimen 7 mm. long sexually mature. Normally these small examples are transparent in the midregion so that the nerve cord, intestinal pellets, and egg-laden nephridia can be plainly seen as yellowish bodies in life. The intestine is characteristically thin-walled, transparent, and highly convoluted and taxes the capacity of the body cavity. Its walls are greatly distended with mud pellets

about 1 mm. long. A specimen from Los Frailes, Baja California, has the intestine distended with sand not in pellets.

The specimen shown in plate 21, figure 4, was 12 mm. long and 9 mm. thick when alive, contracting to about 10 by 10 mm. when killed. The transparent areas of body wall are characteristic and are dotted with grayish or whitish papillae. In life the general tone is greenish or olive, with gray papillae spots, the proboscis bordered with yellow. In the clear area the lateral nerves can be seen as they leave the ventral nerve cord and in favorable specimens the nerve loop can be traced around the entire margin of proboscis.

Dr. Olga Hartman describes small specimens from off southern California as being rich, dark, satiny green in life, while those from Newport Bay Professor MacGinitie found to be decidedly greenish.

Text figures 13 and 14 indicate how widely the nephridia vary in size. In the swollen state the wall is perfectly transparent and excessively thin and the proximal parts of the four vesicles adhere to each other, the distal part lying at random, crowded amid the close coils of the mud-filled intestine. The eggs are suspended in a thin gel, spaced 1 or 2 diameters apart. They vary from 0.09 to 0.1 mm. in diameter and are grayish in color, surrounded by a clear zone (about 0.009 mm. thick). The clearly visible nucleus is 0.045 mm. in diameter.

In text figures 12 and 13 the vascular system is shown in a contracted state. It does not differ in essentials from that of the fully adult (pl. 22).

*Type*.—U.S.N.M. No. 20608.

*Type locality*.—Monterey Bay, Calif., moderate depth, fine sand; from stomach of flounders.

*Specimens examined*.—As follows:

Monterey Bay, 10 large and 4 small specimens.

Tomales Bay, Marin County, Calif., low tide, soft black sandy mud, about 6 inches below surface, 1 large female, June 7, 1941 (University of California).

Newport Bay, Calif., 7 to 20 fathoms, numerous specimens, 4 to 15 mm.; collected by Prof G. E. MacGinitie.

The Allan Hancock Foundation tendered for examination an important collection from Baja California and off southern California, comprising the small phase and some of intermediate size (20 to 40 mm.):

#### BAJA CALIFORNIA

Los Frailes, 5–15 fathoms, sand and algae, 1 specimen.

Upper end of Gulf of California, 21 fathoms, brown mud, 6 specimens.

#### CALIFORNIA

Off Newport Beach, 50 fathoms, mud, 7 specimens.

Off Laguna Beach, 25–57 fathoms, sandy mud, 25 specimens.

Off Bluff Cove (8 lots) 25–100 fathoms, mud, fine sand, 32 specimens.  
Off Redondo Beach (15 lots), 10–120 fathoms, mud, fine sand, coarse sand and mud, 44 specimens.  
Off Point Vicente Lighthouse, 17–40 fathoms, coarse sand and mud, 4 specimens.  
Off Portuguese Point, 16–20 fathoms, gray sand and seaweed, 2 specimens.  
Cortes Bank, 60 fathoms, sand, broken shell, 3 specimens.  
Off Point Mugu, 26–30 fathoms, mud, 2 specimens.  
Santa Catalina Island, 50–51 fathoms, mud, 3 specimens.  
Santa Cruz Island (5 lots), 31–138 fathoms, mud, sand, 15 specimens.  
Santa Rosa Island, 28–45 fathoms, 5 specimens.  
San Miguel Island, 35 fathoms, mud, 20 specimens.

*Remarks.*—The type and largest specimens were recovered from the stomach of flounders from moderate depths of Monterey Bay. In nearly all the examples the intestine is disintegrated and the body cavity filled with pellets of fine sand. This is true also of specimens from southern California, which were dredged and placed almost at once into alcohol.

After the drawings and description were completed I received from Prof. S. F. Light a carefully hardened specimen from Tomales Bay, collected at low tide, in mud frequented by the clams *Schizothaerus nuttalli* and *Macoma secta*. This specimen (June 7) was apparently laying eggs as the nephridia are partly emptied. It is especially valuable as it gives the characters of the adult female, is much better preserved than the Monterey specimens, and affords opportunity for recording the life colors of a large example.

In the type specimen, near the anterior left nephridium is a light-colored lobed mass (pl. 22, x) adherent to body wall. It is possibly a parasite.

#### Genus OCHETOSTOMA Leuckart and Rüppell

*Ochetostoma* LEUCKART and RÜPPELL, 1828, pp. 7–8 (type, *O. erythrogrammon* Leuckart and Rüppell).—SPENGEL, 1912c, p. 316.

*Diagnosis.*—Greater part of the thickness of the longitudinal muscle layer segregated into separate longitudinal bands. The intervals between these bands is crossed by very numerous separate small muscle bundles of the inner oblique layer, which remains for the most part continuous and unbroken over the surface of the longitudinal bands. Anterior nephridia, 1 to 4 pairs, the coelomic aperture having spirally coiled lips; with or without coecum at end of intestine; interbasal muscle of setae present or absent; two ventral anterior hooked setae; no anal setae.

*Remarks.*—The list of species that follows is mostly derived from literature and is in nowise intended to be a revision, for which specimens and new dissections will be absolutely essential. Most of the species were described as *Thalassema*. *Th. exilii* (Fritz Müller) Lampert, which has 8 to 10 muscle bands and two pairs of nephridia,





specimens, varying from less than one-third to the full length of body. Four nephridia, the nephrostome with very long coiled lips. Siphon begins a short distance behind the ring blood vessel (marking the boundary between foregut and intestine); anal vesicles long, with pointed apex and with tiny ciliated funnels scattered over surface; setae without interbasal muscle. Length of full-grown specimen 110 mm.; proboscis 30 mm.; diameter 20 mm. A specimen collected at Cabrillo Beach, San Pedro, Calif., is 95 mm. long; proboscis 93 mm.

*Description.*—Longitudinal muscle bands 8, well developed, broader than the intervals between, rather iridescent and situated as a mid-dorsal, midventral, and (twice) three laterals. These fuse into a continuous sheath on the posterior part of body, equal to about one-third body length of expanded specimens and less of contracted ones. Anteriorly they remain separated to the base of proboscis. The innermost or oblique muscles are well developed, and between the longitudinal muscle bands they form a consecutive series of oblique partitions alternating with narrow compartments. At the bottom of these compartments is a thin layer of the longitudinal middle sheet. In the posterior region the oblique fascicles become less and less distinct as the anal area is approached. In reality the uninterrupted layer of longitudinal muscles is covered by a continuous inner layer of oblique muscles differentiated into thicker and thinner portions. Thus, forward from the anus the gradual differentiation of the separate oblique strands can be easily seen. In severely contracted specimens this posterior region does not show to advantage.

Anterior nephridia, 2 pairs, the ducts piercing the midventral muscle about midway between its outer margin and the nerve cord. The anterior pair is situated a short distance behind the setae (rather less than length of seta). The interval between first and second is a little more than twice the distance. They open internally by ciliated funnels having very long, coiled, extensible lips.

Anal vesicles 2, unbranched, capable of great distension. They open on the ventral surface of cloaca. Tiny scattered ciliated funnels may be seen on the surface.

**ALIMENTARY CANAL.** There are three general regions: (1) An anterior division or foregut, in which the longitudinal musculature lies outside the circular musculature; (2) an intestine proper, in which this order is reversed, characterized by the presence of the ciliated groove and along a part of its course by the collateral intestine or siphon; and (3) a short rectum, or cloaca, posterior to the coecum.

The foregut consists of the pharynx, esophagus, gizzard, and stomach, and the junction with intestine coincides with the position of the ring blood vessel. The pharynx has a tough wall, rather iridescent with wavy longitudinal lines; the esophagus is thin-walled and convoluted, while the gizzard and stomach, both brief, can be differen-

tiated by texture. The gizzard is marked by circular lines, the stomach by longitudinal representing the longitudinal folds of the lining. Complicated dorsal and ventral mesenteries attach the pharynx and esophagus to body wall.

The intestine is, as usual, highly convoluted but when partly unraveled is seen to have a principal posterior loop, and then an anterior. The siphon, or collateral intestine, begins a short distance behind the ring blood vessel, its course being shown in plate 23, figure 1, where the dotted line indicates the ciliated groove, which terminates at the coecum. The walls of the cloaca have thick longitudinal folds. The anal vesicles empty into it by very small pores.

**BLOOD-VASCULAR SYSTEM.** The dorsal vessel, intestinal ring vessel, dorsoventral connectives, and ventral vessel are shown in plate 24. The ventral vessel, which anteriorly follows a part of the free edge of the ventral mesentery, terminates posteriorly on the wall of the coecum.

Color in life, greenish; in alcohol grayish flesh color with eight dark grayish stripes.

*Type*.—U.S.N.M. No. 20607.

*Type locality*.—Newport Bay, Orange County, Calif., January–February 1930, G. E. MacGinitie, 11 specimens.

*Other material examined*.—Cabrillo Beach (San Pedro), Calif., 1 specimen, W. R. Lloyd, Cabrillo Beach Marine Museum.

*Remarks*.—Newport Bay, where Professor MacGinitie collected the type series, is a rather small tidal inlet south of Long Beach. The worms were taken from a sandy bar, exposed at low tide, where they inhabited U-shaped burrows, the mouths of which were 12 to 14 inches apart and the bottom 10 to 12 inches below the surface. A mutilated specimen was dredged in 25 fathoms.

This sand bar was later removed in order to deepen the harbor, and the species was apparently wiped out at that locality as it has not since been taken in spite of much collecting.

The food consists of very fine detritus, which in the intestine is formed into ellipsoidal pellets 2 to 2.5 mm. long by 0.75 mm. thick.

The only species with which *O. octomyotum* might be confused is *O. formosum* (Lampert) from the Philippines and Shanghai. This is a small form averaging 30 mm. in length, proboscis 8 mm., and diameter 10 mm. The color is white in alcoholic specimens, the skin very thin, with white papillae scattered uniformly all over the body. The anal vesicles are described as broad saclike organs. The species has seven or eight muscle bundles, two pairs of nephridia with spirally coiled openings, and a spherical diverticulum on the rectum—characteristics of *octomyotum*, except the number of muscles which is constantly eight in the California species.

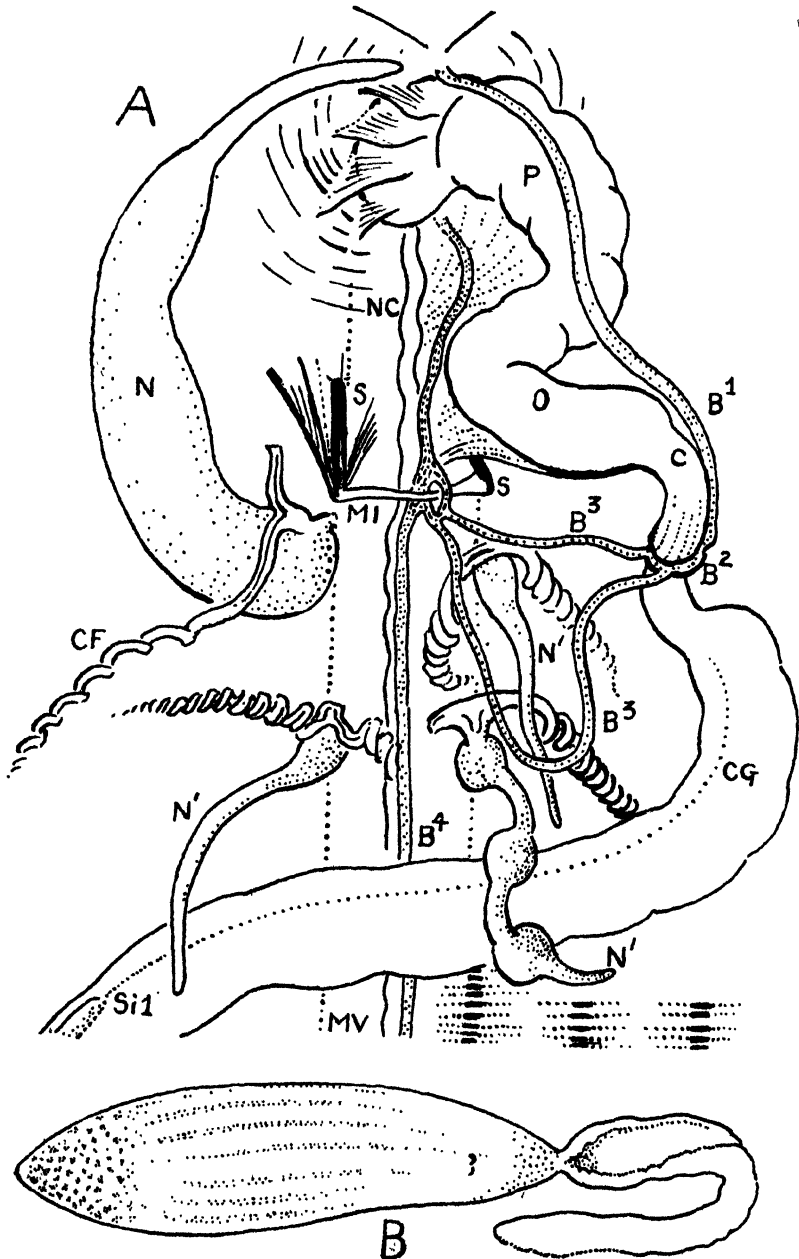


FIGURE 14.—*Ochetostoma edax*, new species: A, Dissection of anterior portion of body to show relations of nephridia, setae, vascular system, and anterior part of alimentary canal,  $\times 6$ . B, Ventral view of specimen from Puerto Refugio,  $\times 2$ . (N, nephridium similar to the four of type, a male;  $N^1$ , female nephridia from a smaller, Puerto Refugio, specimen. Other lettering as on plate 24.)

The specimen from the Cabrillo Marine Museum was taken in sand and is notable for the 93-mm. proboscis, which is 16 mm. broad near the base. The nerve loop, following the margin, is plainly visible.

**OCHETOSTOMA EDAX, new species**

FIGURE 14

*Diagnosis.*—Two pairs of nephridia situated posterior to setae, the nephrostome with spiral lips; setae with interbasal muscle passing through a small loop of the neurointestinal blood vessel; longitudinal muscle bands 16 or 17, with very narrow interspaces; rather long presiphonal intestine; precloacal coecum; two unbranched anal vesicles capable of great distension. Body wall translucent in middle region, striped with narrow dark zones; skin papillae numerous, sometimes whitish, in not well-defined transverse lines, and usually larger on posterior third or fourth of body, but not hard to the touch; proboscis deciduous, fleshy, from one-fourth to body length. Length of body 25 to 50 mm.

*Description.*—The 16 or 17 muscle bands merge into a continuous sheet in the posterior fourth of body. The intervals between the bands are narrower than in *octomyotum* and transverse oblique fascicles of the inner layer are decidedly weaker. The ventral muscle band under the nerve cord is broader than the others. Sixteen is probably the normal number of bundles, the extra band arising from the incomplete splitting of one of the lateral or dorsal bundles.

Nephridia 2 pairs, opening at outer margin of midventral muscle and varying greatly in size. In a male the nephridia are very large, the posterior reaching to posterior end of (contracted) specimen, while in a smaller female they have the relative size of the three smaller nephridia of figure 14. The ciliated funnel on the anterior face of nephridium has long coiled lips. The two anal vesicles, without branches, are covered with ciliated funnels and are capable of being distended to a large size. They are as long as the body in the largest specimen, which is, however, strongly contracted.

**ALIMENTARY CANAL.** Foregut relatively short, ending with the ring blood vessel ( $B^2$ ). Only two parts are clearly differentiated, the pharynx-esophagus and stomach, with longitudinal folds. The gizzard of *O. octomyotum* appears to be lacking. The intestine is long, highly convoluted, with a very much longer presiphonal segment than in *octomyotum*, being longer than the foregut. The wall is thin and in the type is greatly distended with coarse sand; in another specimen, with sizable fragments of shells and miscellaneous hard debris. In the type the presiphonal intestine measures roughly 30 mm., the siphonal part 120 mm. and postsiphonal 90 mm. The

latter has a ciliated groove terminating at the coecum just in front of the cloaca. The walls of the coecum are much thinner than in *octomyotum* and lack heavy longitudinal folds.

**BLOOD-VASCULAR SYSTEM** (fig. 14,  $B^1$ - $B^4$ ). This is on the same plan as in *octomyotum*, but in two specimens the left dorsoventral connective from the ring vessel was much longer than the right. Passing through the small loop where these connectives join the ventral vessel is an interbasal muscle of the setae, not present in *octomyotum*. The ventral vessel ends posteriorly in the coecum without branching.

**COLOR.** "Specimens were elongate to grape-shaped, smooth and thin-skinned, greenish, with obvious and comparatively large spoon-shaped proboscis" (Steinbeck and Ricketts).

**Type.**—U.S.N.M. No. 20606.

**Type locality.**—Gulf of California: Pichalingue Bay, near La Paz, Baja California, February 1920, Luis G. Rubio.

**Specimens examined.** As follows:

Coronado Island, Gulf of California, March 27, 1940, Steinbeck and Ricketts, 3 specimens, under and among slightly subtidal rocks on white sand.

Point Lobos, Espíritu Santo Island, Baja California, March 3, 1940, Steinbeck and Ricketts, 1 specimen, under boulders of tide flats.

Puerto Refugio, Ángel de la Guarda Island, April 2, 1940, Steinbeck and Ricketts, 10 specimens; under boulders on beach. All these are smaller than the type. Same locality, Allan Hancock Foundation, 1 specimen.

**Remarks.**—The type is without proboscis. The sketch of the entire animal is from an example taken at Puerto Refugio. As some of the specimens lack a proboscis and others have only a small one it is probable that the organ is soon regenerated. The wide difference in size seems hardly to be due to accidents of fixation.

The great disparity in size of the nephridia in the two specimens dissected shows that size is of no particular value as a character, depending as it does on the amount of contained material. There is a wide difference also in the size of the anal vesicles in the two specimens.

*O. edax* feeds upon the sand or coarser material in which it lives. This is not molded into definite fecal pellets. The specimen from Puerto Refugio had eaten very coarse material, which formed irregular masses in the intestine. Among the miscellaneous material could be recognized fragments of pelecypod and gastropod shells and small whole gastropod shells; serpulid tubes, calcareous bryozoans, barnacle shells; chelae of small crab; fragments of crab carapace, sea-urchin spines, and brown algae; many straight siliceous sponge spicules and fragments of volcanic rock. Some of the sponge spicules were in bundles. Others had perforated the intestinal wall and were lying in the coelomic cavity. A few were in the anal vesicles.

In the list of species, *edax* is next to *baronii*, which has 17 to 19 muscle bands and anal glands which are described as having short branching outgrowths.

In July 1918 I collected at English Harbor, Antigua, B. W. I., a small *Ochetostoma* that has 19 muscle bands, 2 pairs of nephridia, a strong interbasal muscle passing through a loop of the dorsoventral blood vessel. The anal vesicles are long, reaching to the anterior end of the contracted specimen and are covered with ciliated cups, but there is nothing that can be interpreted as branched outgrowths. The proboscis is much contracted, fleshy, and very adherent. The posterior papillae are white, conspicuous, crowded, so that they are in contact, and are hard to the touch. In a section of the body wall they resemble calcareous nodules. This posterior part of the body is perfectly opaque while the rest is slightly translucent. This species is perfectly distinct from *edax*, and it is noted here because outwardly it would pass for *O. baronii*. The specimen is a mature female with the four nephridia enlarged and full of eggs. Length of body, much contracted, 20 mm.; thickness, 9 mm.; proboscis, 8 mm.

#### Genus ARHYNCHITE Sato

*Arhynchite* SATO, 1937, p. 142. (Type, *Thalassema arhynchite* Ikeda.)

*Diagnosis.*—Differing from *Thalassema* in absence of a proboscis; nephridia 2, with spiral lobes to nephrostome; no intestinal coecum; no ring vessel around foregut at end of dorsal vessel, the connection between dorsal vessel and neurointestinal connective being indirect as in *Bonellia*; muscles of body wall smooth with no concentration of fibers in either the middle, longitudinal layer or in the inner, oblique layer.

#### ARHYNCHITE INAMOENUS, new species

#### PLATE 25

*Diagnosis.*—Differing from *A. arhynchite* (Ikeda) in having a relatively longer neurointestinal blood vessel, which does not embrace the interbasal muscle. Intestine very long, especially presiphonal segment; dorsal blood vessel slender, not connecting directly with neurointestinal vessel, which is relatively long and divided into two before joining ventral vessel; size medium; skin with low papillae.

*Description.*—Length of type, much contracted, 70 mm.; diameter 25 mm. Skin roughened by low, close-set, pustulate verrucae largest and most irregular at ends of body. Setae 2, close to the much contracted anterior end; 11 mm. long, the inner ends united by an interbasal muscle which does not pass through loop of neurointestinal vessel.

Coelomic surface of body wall perfectly smooth and with satiny sheen, the muscles continuous, without trace of differentiation into

longitudinal or oblique bands. Where the seta muscles join body wall there are a few transverse thickenings of inner layer.

Nephridia 2, inserted close to nerve and posterior to seta about the length of latter. In the only female dissected these nephridia are four-fifths length of body and contain numerous eggs. In the male they are about one-fifth length of body and contain sperm. The internal opening (nephrostome) is on a short peduncle near base, with an irregular small lip lacking any trace of spiral structure.

Anal vesicles 2, simple, thin-walled, opening into small cloaca having longitudinally plicate walls. Minute ciliated funnels are scattered over the surface.

Alimentary canal excessively long (600 mm.) with very numerous coils attached to body wall by a multitude of very delicate frenula in which is entangled coagulum containing numerous eggs and brown bodies of unknown nature. The pharynx-esophagus is thin-walled. Plate 25, figure 3, shows the anterior complex more or less in situ and figure 4 with the interbasal setae muscle cut and the pharynx-esophagus pulled to right. The gizzard is about 6 mm. long, but the length of the stomach cannot be determined on account of condition of material. The interval between gizzard and beginning of siphon is the astonishing distance of 170 mm. The siphon accompanies the following 240 mm. of intestine, while the terminal, postsiphonal portion is 190 mm. There is no intestinal cecum in front of the cloaca.

VASCULAR SYSTEM. The dorsal vessel can be traced posteriorly nearly to the point where the long neurointestinal connective ( $B^8$ ) is attached to the lower side of the alimentary canal. The relation is similar to that of *Bonellia*. Anteriorly the neurointestinal connection divides into two branches before joining the ventral vessel. There is therefore no enlarged "heart" at the posterior end of dorsal vessel, nor a ring vessel embracing the gut at that point.

*Type*.—U.S.N.M. No. 20615.

*Type locality*.—Monterey Bay, Calif., 35–40 fathoms, mud, December 3, 1931, 3 specimens.

*Other material examined*.—Off southern California (13½ miles south of Seal Beach), 215–225 fathoms, green mud, Allan Hancock Foundation, 1 specimen.

*Remarks*.—The specimens are in a poor state of preservation, the alimentary canal being soft.

The outstanding features of *inamoenus* are the two nephridia, the internal aperture of which does not have spirally twisted lips; the extraordinarily long presiphonal gut, and the very long neurointestinal connective not embracing the interbasal muscle of setae. The vascular system lacks a definite intestinal ring vessel—probably a generic feature. *A. inamoenus* differs from the only other recognized species, *arhynchite* of northern Japan, in respect to the neurointestinal vessel

already mentioned, and in the probably much longer presiphonal gut. Details of the gut are lacking in Sato's figure and description.

### Family BONELLIIDAE Baird

Bonellidae BAIRD (name only), 1868, p. 111. (Includes *Thalassema* and *Bonellia*.)

**Diagnosis.**—Dimorphic echiuroids. The male is degenerate, planarianlike, with ciliated ectoderm, generally one, exceptionally two, nephridia<sup>10</sup> serving as sperm receptacles, and a vestigial alimentary canal; it lives semiparasitically or parasitically on or in the female,<sup>11</sup> and is sometimes absent from female; females resembling *Thalassema* but with bifid proboscis in some genera; two, four, or exceptionally many anterior ventral setae are sometimes present; no anal setae; anal vesicles with many branches ending in ciliated cups; one to three nephridia.

#### KEY TO GENERA OF BONELLIIDAE

a<sup>1</sup>. With an elongate proboscis bifid at the end.

b<sup>1</sup>. With ventral setae<sup>12</sup> or hooks a short distance behind mouth.

c<sup>1</sup>. Regularly one nephridium or egg receptacle (either right or left).

d<sup>1</sup>. Coelomic aperture of nephridium (i. e., the nephrostome) situated near base of the organ, usually at end of a short lateral tube.

**Bonellia** Rolando

d<sup>2</sup>. Large nephrostome at extreme distal end of nephridium and not facing laterally.....**Bonelliopsis**, new genus (p. 252)

c<sup>2</sup>. Regularly 2 nephridia, having the small nephrostome laterally near distal end; a small blind tube opening between nephridiopores serving as a permanent androecium for completely parasitic male; gonad of female situated on frenula radiating from cloaca; anal vesicles in form of tubules opening independently into cloaca (see also *Acanthohammingia*).....**Pseudobonellia** Johnston and Tiegs<sup>13</sup>

<sup>10</sup> Males of *Pseudobonellia* have two nephridia; other genera one only.

<sup>11</sup> The male lives in the foregut, in nephridium, on proximal portion of proboscis, in genital groove (*Acanthohammingia*), and in a specialized blind tube or androecium opening between the two nephridiopores (*Pseudobonellia*).

<sup>12</sup> In *Bonellia miyajimai* Ikeda (1904, p. 73; 1907, p. 2, pl. 1, figs. 1, 2; pl. 2, figs. 5-17) there are numerous (29) very small setae. *Pseudobonellia* has two to four setae; *Archibonellia* has four and other genera have two setae, but sometimes a complementary smaller seta is in process of growth and later replaces the functional one.

<sup>13</sup> Johnston and Tiegs, 1919, pp. 213-229, pls. 9-11. This is a very remarkable genus set apart from all other bonelliids in having a small blind tube, projecting into coelom and opening on the ventral body wall between the two nephridiopores by a narrow canal whose walls contain strong sphincter fibers. In this lives permanently one very degenerate male, its posterior end grown fast by enlarged ectodermal cells to the much smaller epithelial cells of the tubule. The male lacks setae and has two sperm receptacles, differing from all other known males (which have only one). The ovary is entirely different from that of other genera. "The mesenteric strands of muscular tissue which maintain the posterior portion of the rectum in position are very well developed and form the basis of the ovary whilst from the peritoneum lining them the ova are developed" (p. 221). "The anal glands or posterior nephridia are represented by two small, tuft-like masses situated one on each side of the posterior end of intestine. Each consists of a mass of very delicate, simple, cylindrical tubes opening separately into the rectum, whose walls in this region are thickened. The tubules are approximately circular in section with an irregular lumen. They consist of a single layer of epithelial cells. Near its free end each tubule becomes narrowed before opening into the coelom by a slightly dilated funnel fringed with long cilia" (p. 220).

This species was collected in the Capricorn Group, Great Barrier Reef, due east from Keppel Bay, Queensland. Subsequently Monro (1931, p. 33) reported the species from Low Isles.



- c<sup>3</sup>. Three nephridia, an unpaired between a pair; ovary along nerve cord; anal vesicles: a fascicle of tubules at end of a collecting tube.  
**Archibonellia** Fischer <sup>14</sup>
- b<sup>2</sup>. No setae present.
- c<sup>1</sup>. Nephrostome situated at end of a short lateral tube near blind distal end of nephridium.....**Parabonellia** Onoda
- c<sup>2</sup>. Distal end of nephridium expanded into plicated rim of large nephrostome.....**Eubonellia**, new genus (p. 255)
- a<sup>2</sup>. Proboscis when present similar to that of *Thalassema* and not bifid at extremity.
- b<sup>1</sup>. No sharply marked groove between nephridiopore and mouth.
- c<sup>1</sup>. Female with 2 well-developed ventral setae; anal vesicles 2, elongate, dendritic; nephrostome near base of the single nephridium; male unknown.....**Protobonellia** Ikeda
- c<sup>2</sup>. Female with 2 ventral setae; nephridia 2, large, with basal 2-lipped nephrostome; anal glands wide sacs provided with a very large number of slender excretory tubules with apical funnel; male unknown.  
**Maxmülleria** Bock
- c<sup>3</sup>. No ventral setae in female.
- d<sup>1</sup>. Proboscis deciduous, *Thalassema*-like; 2 external papillae marking nephridiopores; nephridia 2 or 1 with basal nephrostome; anal vesicles in 2 thick clusters of tubules opening into a common duct; male with ventral hooks.....**Hamingia** Danielssen and Koren
- c<sup>1</sup>. In place of proboscis a short truncate snout; a proboscis possibly normally present; 1 nephridium with basal nephrostome; duct of nephridium passing under nerve cord and opening in median line into a funnel-shaped depression of skin; anal vesicles; numerous dendritic masses arising from a basal bladder on each side of large muscular cloaca; terminal portion of hind-gut, in front of cloaca, greatly enlarged; male unknown.....**Nellobia**, new genus (p. 257)
- b<sup>2</sup>. A narrow, or expanded, slit extending forward from nephridiopore, in 2 species containing 8-10 tiny, integumentary spines; anal vesicles not in form of 2 dendritic structures or 2 clusters of tubules, but in form of independent branched tubes or an asymmetrical cluster; 1 or 2 nephridia with nephrostome near base; males with or without hooks.  
**Acanthohamingia** Ikeda (p. 260)

<sup>14</sup> Wilhelm Fischer, 1919, p. 283, figs. 5, 6; 1926b, p. 207, pl. 2, figs. 1-7, text figs. 1, 2. *Archibonellia michaelsoni*,<sup>15</sup> the type, from a coral reef, Rottneust Island, Fremantle, Australia, is only 12 mm. long; it has a large median between and above two small nephridia (no nephrostomes were found). The proboscis has two terminal lappets instead of divisions, and the alimentary canal is short, scarcely over twice length of body. *A. mjöbergi* (1926b, p. 208, fig. 1, northwest coast of Australia), however, has a very small unpaired nephridium (with basal nephrostome) between a pair of very large "uteri" filled with eggs and with terminal nephrostomes. The alimentary canal is of normal length for a bonellid, and the proboscis is normally cleft at the tip. Fischer, in a quandry what to do with this species, places it in *Pseudobonellia* on the basis of the large paired nephridia, with terminal nephrostomes, and the normal alimentary canal and proboscis. Even though the androecium of *Pseudobonellia* may well have originated in an unpaired nephridium, the fact remains that in *Pseudobonellia* the androecium is highly specialized and is no longer a nephridium, while the ovary is not found along the nerve cord, as in *Archibonellia*, and the tubes of the anal vesicles open separately into the cloaca, not into a common duct. The two species of *Archibonellia* may not be congeneric, but the aberrant species is certainly widely different from *Pseudobonellia*.

FIGURE 15.—*Bonellia viridis*: Dissection (× 5) of anterior part of specimen from Naples to show particularly the position of nephrostome, CF, at base of nephridium, N, which was 55 mm. long while the animal was only 45 mm. Note the long segment of gut between gizzard, G, and beginning of siphon, Si1. The anterior end of gonad, Go, is shown. (B<sup>1</sup>, B<sup>2</sup>, B<sup>3</sup>, dorsal, neurointestinal, and ventral blood vessels; C, stomach; G, gizzard; NC, nerve cord; O, esophagus; P, pharynx.)

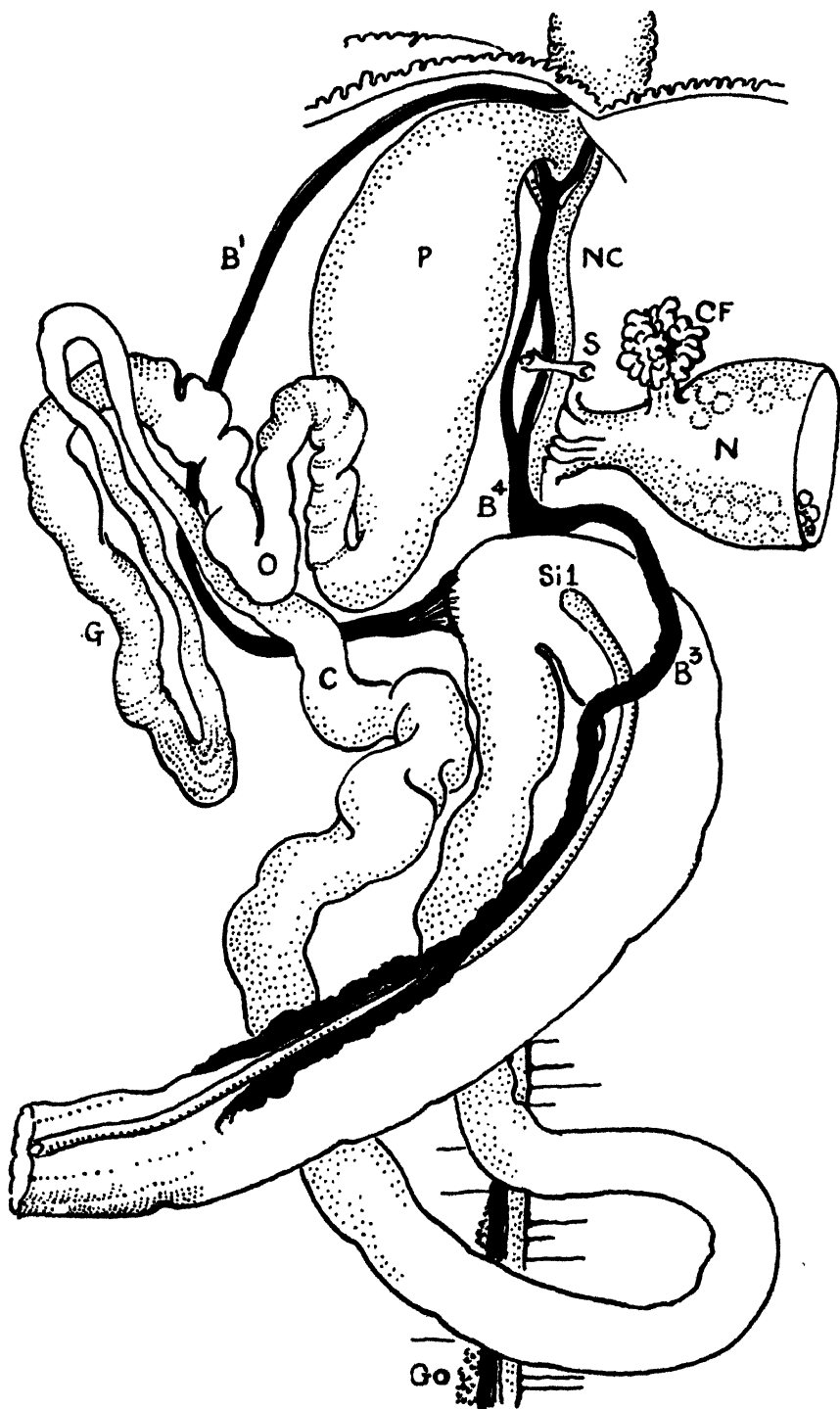


FIGURE 15.—(See opposite page for legend).

**BONELLIOPSIS, new genus**

*Diagnosis.*—Differing from *Bonellia* in having the nephrostome at the distal end of the nephridium instead of near the base, and in the possession of a much shorter presiphonal foregut; either left or right nephridium developed; females with two ventral setae; males without setae.

Type, *Bonelliopsis alaskana*, new species.

**BONELLIOPSIS ALASKANA, new species**

FIGURE 16; PLATES 26, 27

*Description.*—Body elongate, subcylindrical, blunt at both ends, 20 to 65 mm. long, and commonly four or five times as long as thick; proboscis of usual *Bonellia* form seldom exceeding body length and usually considerably shorter. Contracted skin verrucose, the verrucae squarish, not obviously larger in any particular region; when skin is stretched the verrucae flatten out into squarish glandular thickenings arranged in irregular longiseries.

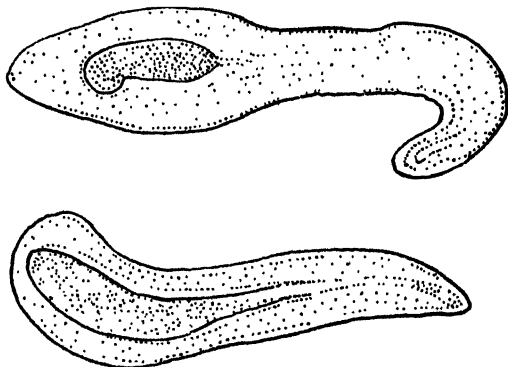


FIGURE 16.—*Bonelliopsis alaskana*, new species: Two males, the upper 1.27 mm., the lower 1.9 mm. long,  $\times 50$ . The spermatheca is most heavily shaded; the lightly stippled is parenchymatous and muscle tissue; sperm duct opens at anterior (right) end.

Body wall thin, translucent. Inner, circular layer of muscles smooth, but in the region of foregut where the layer is thickest there is a division into slender fascicles.

Setae 2, small, nearly straight, situated close together a short distance behind mouth (4 mm. in specimen 44 mm. long). There is a short but broad interbasal muscle which usually presses upon the nerve cord and ventral blood vessel.

Nephridium 1; of six specimens dissected four had the left nephridium developed and two had the right. It is situated close to the nerve cord directly behind the setae. In some specimens the nephridiopore is conspicuous externally. The nephrostome is conspicuous, terminal, with amply folded lips. When the nephridium is filled

with eggs its distal end is usually invaginated, concealing the nephrostome (pl. 27, fig. 1). The mucosa is thrown into shallow longitudinal folds, most pronounced at proximal end.

The two anal vesicles have the relative size and general form indicated in plate 26, figure 1, where only one is shown. Each opens by a small pore into the cloaca. The primary branches of the vesicle vary in number. In plate 26, figure 2, is shown the tip of one of the major subdivisions including two of the smaller secondary branches, each of which bears several funnels.

**ALIMENTARY CANAL.** As contrasted with *Bonellia viridis* the alimentary canal differs in having a much shorter foregut, especially the portion between the gizzard and the intestine, corresponding in general to the "stomach" of *Thalassema* and allies. The abruptly enlarged intestine is produced forward into a coecum where the dorsal blood vessel envelops the intestinal wall. In the specimen of *B. viridis* that I dissected this was not differentiated (fig. 15).

The pharynx is connected with the body wall by numerous radiating muscular frenula of which only a few are indicated in the figures. The mucosa is thick, verrucose, and not very different from that of the esophagus. The gizzard has stronger ring muscles than the esophagus (which shows a ringed structure), and the mucosa is thrown into consecutive ring folds. When spread out these ring folds subdivide into eight longitudinal divisions. Behind the gizzard the mucosa becomes abruptly thinner, and between the gizzard and this elongated stomach there is a sort of pyloric constriction, with a very narrow passage. The opening, on the stomach side, is surrounded by a flange of tissue. There is no presiphonal ciliated groove, but a postsiphonal one runs along the intestine to the point where the ventral blood vessel and genital stolon join the hind-gut. The fecal pellets are slender blunt ellipsoids 2.5 mm. long. In one I found an ostracod and a small *Balanus*.

**MESENTERIES.** The mesenteries are continuous, very thin sheets, even in the postsiphonal region of the intestine. In plate 27, figure 2, an attempt has been made to show the principal mesenteries of the foregut, which are voluminous and folded when the animal is contracted. In this semidiagrammatic drawing the left half of the animal only is shown. What is probably the ventral mesentery (VM) is attached to body wall over a sinuous and not so smoothly regular course as shown in figure. It is fastened to the left side of pharynx-esophagus, passing gradually to the side of the intestine opposite the siphon. The posterior part of dorsal blood vessel ( $B^1$ ) is attached to, or involved in, this mesentery. The dorsal mesentery (DM) is attached to the body wall in a long spiral passing from right side (dot and dash line) over to left side. Posteriorly it merges with the ventral mesen-

tery on its left side, where the foregut enters the intestine. In the drawing the posterior face of dorsal mesentery is shown and only a small part of the anterior (or dorsal) side adjacent to pharynx. The attachment to the gut is along the lateral line, but behind gizzard the attachment moves over near to that of ventral mesentery. A special muscular mesentery indicated in plate 27, figure 1, but omitted from figure 2, joins the gizzard to the stomach. A special transverse dorsal muscular mesentery supports the dorsal blood vessel anteriorly. When the animal is extended the effect of these mesenteries is to form a somewhat spiral anterior cul-de-sac in which the nephridium lies and in which the eggs probably congregate. But when the nephridium is full of eggs, as in plate 27, figure 1, there may still be hundreds of eggs, seemingly mature, in various parts of the coelom.

**VASCULAR SYSTEM.** The distribution of the principal trunks, shown in the figures, seems to be almost the same as in *Bonellia viridis* (fig. 15). The connection between the dorsal and ventral vessels is not direct, as in *Echiurus*, *Ochetostoma*, and *Thalassema*, but by means of lacunae in the intestinal wall, as is the case in *Arhynchite*.

The gonad lying along the top of the ventral blood vessel, in the posterior half of body, seems to be identical with that of *B. viridis*.

**MALE.** The males are found in the foregut, from the pharynx to the gizzard, in the order of about a dozen to an individual. In one case I found two or three in the anterior part of the stomach. Dr. H. Heath, who collected the type series, examined several live specimens and found no males in the nephridium.

The males vary from elongate-slender to the shortened state shown in figure 16. When fully extended they are more than twice as long as figure and only about half as thick. The sperm receptacle is situated posterior to middle of body and the duct opens at anterior end, or very close to it. There is very little free coelom, the body being filled with parenchymatous and muscle tissue, diagrammatically indicated by the more spaced dots in figure. No setae are present.

*Type*.—U.S.N.M. No. 20603.

*Type locality*.—Dutch Harbor, Unalaska, under rocks, at low tide; Harold Heath, August 1917, 15 specimens.

*Specimens examined*.—In addition to the above, 25 specimens, without locality, U. S. National Museum.

*Remarks*.—The type series was collected by Dr. Harold Heath, who found them in the intertidal zone under flat rocks. The worms were arranged around the periphery of the stone with the proboscis extended to the margin. In life the animals are light green, the color of "green prunes," which, in the contracted state, they somewhat resemble.

## EUBONELLIA, new genus

*Diagnosis*.—Bonelliidae with well-developed bifurcate proboscis, no setae, and a single (right) nephridium, the distal end of which is expanded into the plicated rim of the large nephrostome; anal vesicles essentially as in *Bonellia*; male with sperm receptacle reaching nearly to posterior end of body; body wall thick.

Type, *Eubonellia valida*, new species.

*Remarks*.—This genus differs from *Bonelliopsis*, the only other known to have a strictly terminal nephrostome, in lacking setae. Its foregut has an unusually extensive stomach or crop, between the gizzard and beginning of siphon, this segment being short in *Bonelliopsis*. The mesenteries of the intestine of *Eubonellia* are in the form of strands, not a sheet.

*Parabonellia* Onoda,<sup>15</sup> based on *Bonellia misakiensis* Ikeda,<sup>16</sup> also lacks setae in both male and female. The nephridium has a small pedunculate funnel situated, not at the base as in *Bonellia*, but on the side of the vesicle near the terminal blind end. Ikeda did not show this in his figure of a "dissection" of the type, but it is figured by Onoda (fig. 1) and Sato<sup>17</sup> (fig. 2). None of these writers has figured or described significant details of the foregut, which are of importance in classification.

The body wall of *Parabonellia* is thin while that of *Eubonellia* is very muscular, but this is a character varying with the contraction of the specimen and is scarcely of generic significance.

In *Eubonellia* the male is about half the size of the male of *Parabonellia*, which is described as nematodelike, 3.3 to 3.5 mm. long, and 0.2 to 0.3 mm. in breadth. The sperm vesicle and canal occupy the anterior fifth to third of the body. In *Eubonellia* the vesicle extends nearly to the posterior end of the body, which is depressed, planarian-like.

*Protobonellia* Ikeda<sup>18</sup> (type, *P. mitsukurii*, Sagami Bay, Japan, 300 fathoms) has very strong setae with unusually well developed muscles. The proboscis is similar to that of *Thalassema*, and the single (left) nephridium is similar to that of *Bonellia*. The nephrostome is a wide fimbriated funnel at the end of a slender tube opening into the nephridium near the base of that organ. The anal vesicles are similar to those of *Bonellia* rather than *Hamingia*, which the proboscis might lead one to expect. The vascular system seems to possess a peculiarity in a rather direct connection between the dorsal vessel and the neuro-intestinal connective at a point immediately anterior to the beginning of the siphon. Ikeda treats this very summarily in both

<sup>15</sup> Onoda 1934, p. 418 (*Pseudobonellia*); 1935, p. 141 (*Parabonellia* for *Pseudobonellia*, preoccupied).

<sup>16</sup> Ikeda, 1904, p. 74, figs. 24, 103-105.

<sup>17</sup> Sato, 1935, p. 142, figs. 1, 2.

<sup>18</sup> Ikeda, 1908a, p. 259, figs. 1-4.

description and figure, apparently not realizing that it is different from the relations of the two vessels in *Bonellia*. Neither his figure nor description gives any definite details concerning the foregut beyond the fact that it is very long.

EUBONELLIA VALIDA, new species

PLATE 28

*Description.*—The much-contracted type is oblong-cylindrical, 55 mm. long, and about 20 mm. thick at middle. The conspicuous nephridiopore is 8 mm. behind mouth. Proboscis unusually broad and flat, terminally bifurcate, without a ventral sulcus. In its contracted state it is 30 mm. long and 7–9 mm. broad (pl. 28, fig. 3). The thick skin is thrown into annular welts, the furrows being frequently interrupted. These folds do not carry marked pustulate thickenings as in the case of *Nellobia* found at the same station. From the mouth a short narrow sulcus extends upon the constricted base of proboscis.

Body wall tough and muscular, 1.5 to 2.5 mm. thick, the middle longitudinal layer being the thickest. The inner, circular layer is smooth, but somewhat fasciculated at anterior end of body.

No setae or vestiges of seta sacs or muscles.

The single large (right) nephridium has a terminal large nephrostome with voluminous lips. At the base a simple duct leads to the exterior approximately in the median line.

The two anal vesicles are of the elongate dendritic type with a voluminous axial bladder having a few branches proximally. To the main stem and branches are attached singly or in clusters (pl. 28, fig. 2) the nephritic elements, which are characteristically very elongate, ending in pedunculate funnels. The vesicles are attached to each side of a very small cloacal bulb, the mucosa of which is thrown into longitudinal ridges.

**ALIMENTARY CANAL.** The anterior part of pharynx is attached to body wall by numerous frenula, but there is no peripharyngeal diaphragm such as is characteristic of *Nellobia*. There is a rather delicate mesentery at the bend of the esophagus (not shown in figure). Food pellets form in the posterior part of esophagus (*O*<sup>1</sup>), as well as in the gizzard (*G*), and are collected in the elongate stomach. The wall of the stomach is almost transparent. Between it and the gizzard there is a powerful sphincter forming a sort of pylorus as in *Bonelliopsis*. There is a weaker sphincter between the esophagus and gizzard.

There is no presiphonal ciliated groove. Much of the intestine is missing, but enough remains to show that there is an extensive portion, traversed by the siphon, which has thicker walls so that the pellets are not visible, whereas the postsiphonal intestine (with a

ciliated groove) has very thin walls and very compact pellets (pl. 28, fig. 4). The ciliated groove ends at entrance to small cloacal bulb and a strand of tissue from the ventral blood vessel is attached at this point.

The vascular system is of the usual bonelliid type and can be followed in the figure. The ventral vessel divides into two at about the point where setae would be if present.

The gonad, in the usual bonelliid position, is confined to the median third of the body and is inactive, there being no sign of egg formation. In *Nellobia*, dredged at the same time, the gonads were active and the nephridium full of eggs.

MALE (pl. 28, fig. 5). One was found in the pharynx near mouth. It is possibly not fully matured; length 1.17 mm. The dark body is the sperm vesicle, the duct opening at the anterior end as in *Bonellia viridis*. The small spot back of the gonad is probably the excretory pore. Small indistinct masses of spermatozoa can be seen in the coelom, but have not been shown in the drawing. The gonad is situated more posteriorly than in *Bonellia viridis*.

Type.—U.S.N.M. No. 20604.

Type locality.—Albatross station 5021, Okhotsk Sea, off east coast of Sakhalin Island, lat.  $48^{\circ} 32' 30''$  N., long.  $145^{\circ} 08' 45''$  E., 73 fathoms, green mud, sand, pebbles, bottom temperature  $30.9^{\circ}$  F.

#### NELLOBIA,<sup>19</sup> new genus

*Diagnosis*.—Bonelliidae without setae and possibly without proboscis; one nephridium (left), with a basal nephrostome and swollen basal region, opening in the median line but without a genital groove; two compound anal vesicles each consisting of numerous trees arising from a sessile receptacle on either side of the very large muscular cloaca; terminal portion of hind-gut greatly enlarged; body wall very thick.

Type, *Nellobia eusoma*, new species.

*Remarks*.—This genus differs from *Bonellia*, *Protobonellia*, *Parabonellia*, *Eubonellia*, and *Bonelliopsis* in the radically different structure of the anal vesicles and from all bonelliids in the extremely large muscular cloaca and enlarged terminal part of the hind-gut. The only group which has fundamentally similar anal vesicles is *Acanthohammingia* Ikeda<sup>20</sup> in which three trees arise independently on each side of the cloaca (*A. ijimai*) or more numerous as a cluster with probably some connection between the elements (*A. shiplei*). In *Hammingia arctica* Danielssen and Koren<sup>21</sup> there is a very short (1 mm.)

<sup>19</sup> Anagram of *Bonellia*.

<sup>20</sup> Ikeda, 1910, p. 136, pl. 10; see also 1908, p. 61, pl. 1.

<sup>21</sup> Danielssen and Koren, 1881, p. 20, pl. 4 and 5, figs. 1-18.



tube on each side of the cloaca to which very numerous small trees are attached at approximately the same point.

The vascular system of *Nellobia* is similar to that of *Bonellia* and allies in the relation between the dorsal blood vessel and the neuro-intestinal trunk. No direct connection exists between the two by obvious anastomosis of terminal branches such as Danielssen and Koren figure (1881, pl. 5, fig. 14).

NELLOBIA EUSOMA, new species

PLATES 29, 30

*Description.*—The single specimen is contracted to the maximum extent. The posterior end of the body is invaginated to form a cup-shaped depression. The intestine had been extruded, after the manner of holothurians, through a breach in the cloacal wall, and most of it is missing.

Body of *Bonellia* form without proboscis, 44 mm. long (allowing for posterior invagination), and 15–17 mm. thick at middle. Owing to contraction, the skin is thrown into irregular transverse folds with frequent pustulate thickenings, less regular in the anterior ventral region (shown in pl. 29, fig. 1) than elsewhere. If the very short truncate snout is the remains of a longer proboscis, it is nevertheless covered with normal skin. The conspicuous opening of the nephridium is close to the median line about 4 mm. behind mouth.

The body wall is very muscular and in the contracted state about 2 mm. thick. The middle longitudinal layer is the thickest, the inner circular layer the thinnest. The latter in the contracted state of the specimen shows definite fascicles of uneven width which would probably smooth out when the worm is expanded.

The single nephridium (pl. 30) is attached on the left of the nerve cord, but its duct passes under the cord to open in the median line. The nephrostome has very simple lips and passes into a bulbous and thick-walled proximal region. The distal compartment, filled with eggs, has the wall stretched to translucent thinness but its proximal constricted part has glandular walls furrowed longitudinally. There is a definite opening from the egg chamber into the proximal bulbous portion.

The anal vesicles are peculiar. Instead of having a roughly treelike form as in *Bonellia* and *Bonelliopsis*, the main vesicle is a sort of crescent-shaped pouch applied to each side of the large cloacal cavity and produced on the opposite or free border into numerous (a dozen or more) unequal dendritic subdivisions. The larger of these have a few main branches like a tree, which in turn are crowded with branchlets (pl. 29, fig. 4) carrying many of the bulbous glandular elements ending each in a ciliated funnel. Around the base of these primary

nephridia are numerous subglobular unequal yellow bodies arising from the base of the nephritic elements and from the wall of the collecting tube or branchlet. Numerous much smaller brownish-yellow papillae occur on the walls of the main stems and branches. I could not find the opening into cloaca.

**ALIMENTARY CANAL.** The main features of the foregut are shown on plate 30. The pharynx is attached to body wall by very numerous crowded radiating strands. This head cavity is separated from the rest of coelom by a translucent diaphragm (*D*) indicated in the drawing incompletely. Its central border encircles the gut behind the pharynx, and what may be conventionally called the esophagus (extending to *X* in drawing) has the muscular walls marked by prominent ring folds which cause the mucosa to be thrown into transverse welts. This muscle layer thins toward end of esophagus and the ring becomes narrower. The segment *X*–*Y* corresponds to the gizzard of *Bonelliopsis*. The annulation of muscle is closer. At *Y* the canal was broken, and it is possible that something was lost as the segment between *Y* and the beginning of siphon is very short. It corresponds to the so-called stomach of *Bonelliopsis*. A tough mesentery unites loops of the esophagus, whereas in *Bonelliopsis* the thicker mesentery joins the gizzard to stomach. The esophagus has a continuous ventral mesentery attached ventrodextrally but the other mesenteric attachments to body wall are in strands or frenula.

The cloaca is bulbous, with very numerous muscular strands uniting its rather muscular wall with body wall. The anterior of these strands pass between the branches of the anal vesicles. The very expanded hind-gut seems to be more than an accident of killing, as the condition of the mucosa indicates that the walls have not been unnaturally distended. The prominent ciliated groove continues from the narrow segment (all the rest of the intestine having been lost) to the beginning of the cloaca, where a strand from the ventral blood vessel ends. There is no intestinal coecum at this point.

The vascular system is of the *Bonellia* type. The neurointestinal connective (*B*<sup>3</sup>) spreads out fanwise where it joins the ventral vessel (*B*<sup>4</sup>) and its walls appear to be glandular as if a part of the gonad complex. Actual ova are found as far forward as the posterior border of this fan.

The gonad is of the *Bonellia* type but extends unusually far forward.

**MALE.** Unknown. The foregut was quite empty, and no males were found in the nephridiopore.

**Type.**—U.S.N.M. No. 20605.

**Type locality.**—Albatross station 5021, Okhotsk Sea, off east coast of Sakhalin Island, lat. 48° 32' 30'' N., long. 145° 08' 45'' E., 73 fathoms, green mud, sand, pebbles, bottom temperature 30.9° F.

## Genus ACANTHOHAMINGIA Ikeda, emended

*Acanthohamingia* IKEDA, 1910, p. 136. (Type, *A. shiplei* Ikeda.)

**Diagnosis.**—Differing from *Hamingia* in having a well-marked genital slit extending forward toward mouth from the one or two nephridiopores, this containing, in two species, 8 or 10 very small setae imbedded in the skin; anal vesicles numerous, at least not in two symmetrical clumps which arise from a very short common duct; body wall thin; proboscis (when known) similar to that of *Thalassema*; males with or without ventral setae.

**Remarks.**—The new species described below has necessitated an emendation of the original diagnosis since there are no minute setae in the genital groove. This groove, which extends forward from the nephridiopore, or pores, occurs in the three known species<sup>22</sup> and is not present in any other genus. The general habit of the three species is much the same, as they are all of delicate build. The body wall is thin, translucent when expanded, and skin papillae are poorly developed. The anal trees exhibit differences in the three species, being most alike in *A. ijimai* and *A. paradola*. These are numerous, independent, or semi-independent branched tubules, and differ from the condition in any other genus except *Nellobia*. But in *Nellobia eusoma*, which lacks any trace of a genital groove and is one of the most heavily built of all bonelliids, the anal trees spring from a bladderlike structure applied to each side of the very muscular cloaca. The rudimentary bladder figured for *A. paradola* (left side) may well indicate the last trace of a similar structure.

In *A. shiplei* and *A. ijimai* the male is long and slender and lacks setae, whereas in *A. paradola* the male is lanceolate and planarian-like and is provided with two curved setae.

## ACANTHOHAMINGIA PARADOLA, new species

## PLATES 31, 32

**Diagnosis.**—Differing from *A. shiplei* and *A. ijimai* in the absence of minute setae from the genital groove of female and in the presence of a pair of ventral curved setae in the male; nephridia 2 instead of 1; anal trees numerous, slender, sparsely branched, arising for the most part independently from the very thin wall of the cloaca. Length of paratype 90 mm. (pl. 31, fig. 1). Color, pale flesh when seen on a white background.

**Description.**—The general habit is much like that of *A. ijimai* but proboscis is lacking. The body wall is very thin and translucent, this thinness being accentuated by inflation. Along the midventral line the extremely slender nerve cord can be easily seen. The skin

<sup>22</sup> *A. shiplei* Ikeda 1910, p. 136, pl. 10; *Hamingia ijimai* Ikeda, 1908b, p. 62, pl. 1.

is marked by flat circular spaced spots slightly less translucent than the intervals. Back of the mouth is the characteristic genital groove, which normally is probably very narrow as in the type (pl. 31, fig. 3) but in the paratype (pl. 31, figs. 2, 2a) is spread apart owing to stretching of body wall. In this groove are four males. In the type there is at least one. At the posterior end of groove are the openings of the nephridia: two in the type and another specimen (pl. 31, figs. 4, 4a); one in the paratype (pl. 31, figs. 1, 2). The hemispherical papilla shown in these figures beside the nephridiopore is an artifact. Although there is but one opening there are two large nephridia containing eggs.

As stated above, the body wall is very thin, on the order of 0.15 to 0.2 mm. thick, and a single thickness is so transparent that printing can be easily read through it. The fibers of the longitudinal and circular muscles can be seen under magnification, but there are no bundles.

All three specimens are in poor condition internally as the midgut and hind-gut are badly macerated, the contained pellets being adrift in the coelom. The more essential foregut can be made out with the associated blood vessels.

The nephridia, in good condition, number two in all three specimens. They have exceedingly thin walls, and the small nephrostome and its short stalk are situated at the base, close to the swollen ducts leading to nephridiopores. In the paratype the nephridia are about twice as large as those shown on plate 32.

The significant features of the alimentary canal can be seen on plate 32. The pharynx is much inflated (but probably unnaturally) and has very thin walls. The esophagus can be traced to  $O^1$  where the fine longitudinal ridges of the mucosa change to equally small rings. Then follows an exceptionally long segment of the foregut in which I can find no marked division into gizzard and stomach (or "crop"). In this the contents are shaped into oblong pellets 1.5 to 2 mm. long. Extremely slender and numerous frenula connect the pharynx to body wall. The continuous ventral mesentery of foregut is delicate and transparent. The position of the coils of foregut in figure has no significance as they had mostly broken moorings. All the foregut is thin-walled.

In connection with the vascular system the very considerable length of gut between attachment of dorsal vessel ( $B^1$ ) and neurointestinal connective ( $B^3$ ) may be noted. The ventral expansion of  $B^3$  is considerably farther back in another specimen. In keeping with the rest of the animal the blood vessels are delicate and the ventral trunk is very inconspicuous. There are numerous opaque nodules on the neurointestinal trunk.

The nerve cord is the slenderest I have seen in a mature echiuroid, being only 0.135 mm. in diameter.

The gonad, on the irregular margin of a mesentery dorsal to nerve cord, is invisible except under high magnification, as the cells are small and inactive. The whitish eggs in the nephridia are 0.5 to 0.6 mm. in diameter.

Anal vesicles are in the form of numerous slender tubes with spaced short lateral branches (pl. 31, fig. 6). These tubes are involved in and fastened to body wall by transparent but strong frenula. In the type nearly all the tubes of the left side spring from a small irregular common chamber closely appressed to the transparent wall of the cloaca, but on the right side no such common chamber is present. Here the vesicular tubes arise independently from the cloacal wall. It is probable that the number of tubes increases with age. The ultimate subdivisions are not well enough preserved for exact delineation but they resemble in general those of *A. ijimai*. Although the cloaca is not perfect in any of the specimens, that of the type shows a rather large subspherical chamber with transparent walls joined to the body wall by a multitude of frenula.

**MALE.** Males occur in the genital groove as shown in plate 31, figure 2. Probably the groove is normally as in the type, which has one or two males in it. They are depressed lanceolate in form, 1.2 mm. long, and the tube of the sperm receptacle opens at the middle of the anterior end, the receptacle itself being about in the middle of body (pl. 31, fig. 5).

*Type*.—U.S.N.M. No. 20601.

*Type locality*.—Albatross station 4942, Kagoshima Gulf, Japan, 118 fathoms, brown mud, black specks, bottom temperature 59.8° F., 2 specimens.

*Specimens examined*.—The above and 1 specimen (paratype) from station 4940, same locality, 115 fathoms (pl. 31, fig. 1).

### XENOPNEUSTA, new order

No blood-vascular system, the coelomic fluid being heavily charged with large blood corpuscles containing hemoglobin or hemoglobin and hematin; intestine with terminal portion in front of cloaca enlarged, thin-walled, functioning as an organ of respiration in connection with anus and cloaca.

#### Family URECHIDAE Fisher and MacGinitie, 1928

*Diagnosis*.—Differing from other Echiuroida in the absence of a blood-vascular system, the corpuscles (red or brown in color from hemoglobin or hemoglobin plus hematin) free in the coelomic fluid; distal portion of midgut greatly enlarged and in connection with cloaca serving as a respiratory apparatus; foregut very long,

including a long gizzard between an anterior long crop and a posterior long stomach; proboscis reduced to a scoop-shaped upper lip.

Genus *URECHIS* Seitz

*Urechis* SEITZ, 1907, p. 352 (type, *Echiurus chilensis* Max Müller, 1852).—FISHER and MACGINITIE, 1928a, p. 200.

*Spiroclotelor* SKORIKOV, 1909, p. 77 (type, *Echiurus uncinatus* von Drasche).

*Diagnosis*.—Cylindrical or sausage-shaped echuiroids with characters of family. Body wall is very muscular, consisting of outer and inner circular layers and middle longitudinal layer, the latter the thickest; inner layer showing a fasciculate arrangement superficially. In the region of the posterior pair of nephridia is a zone of compound slime-net glands lodged in the verrucae of the skin. There are two or three pairs of nephridia, the basal nephrostome of which has long spirally coiled ciliated lips for collection of mature germ cells. The two anterior setae have a strong interbasal muscle; one ring of curved anal setae interrupted ventrally. Traversing the coelomic cavity in front of the anterior setae are paired dorsoventral muscles (pl. 34, fig. 2, 13). The alimentary canal has a definite pattern of attachment to body wall by muscular mesenteries, differing in minor details in the three species (pl. 35, fig. 1). The slender foregut is very extensive, consisting of pharynx, esophagus, crop (subtended by a powerful muscular mesentery not attached to body), a long gizzard, and a stomach attached posteriorly by a strong mesentery. The greater part of the very long midgut is accompanied by the siphon, which starts close to distal end of stomach. The ciliated groove of midgut, which parallels the siphon, extends beyond it to the point where the gut is suddenly expanded into the inflatable respiratory portion. The external ridge marking the ciliated groove continues along dorsal side of this expansion, passing distally to the right where it affords attachment for mesenteries, but there is no groove inside corresponding to it. This inflatable so-called "hind-gut" is equivalent to the terminal part of the midgut of *Echiurus* (which is not enlarged). The only similar abrupt enlargement occurs in *Nellobia eusoma*. The true hind-gut or cloacal cavity is separated from the foregoing by a definite sphincter constriction and consists of a thin-walled anterior portion and a thicker-walled terminal section with rugose mucosa. Very numerous frenula attach cloaca to body wall and account for the expansion of cavity by which water is inhaled during respiration. The anal vesicles are voluminous, slender sacs, always deflated, which open ventrally into terminal portion of cloaca. The glandular walls are externally rather cauliflowerlike and the entire inner surface is intricately plicated. The scattered ciliated funnels are very tiny. The anus is eccentric to the circle of setae, being slightly nearer the ventral side (pl. 33, fig. 4).

*Remarks.*—Three well-known species have a very uniform outer facies. Although *unicinctus* of Japan has only two pairs of nephridia, it is indistinguishable by external features from small examples of *caupo*. The details of skin and setae are practically identical. The alimentary canal, except for minor details of mesenteries, is closely similar in the two species. Apparently *unicinctus* does not reach the large size of *caupo* and *chilensis*, both of which have a third (posterior) pair of nephridia. The anterior setae of *chilensis* are blunt and scarcely tapered while in the other two species they are strongly tapered and sharp. In *chilensis*, as compared to *caupo*, dorsoventral muscle 13 is weaker, the crop and gizzard are longer, and the interval between end of stomach and beginning of siphon is about three times greater. The attachment of the anterior end of the respiratory portion of midgut (pl. 36, figs. 1, 2) presents important differences.

*Urechis chilensis* (Müller), synonym *U. farcimen* (Baird), is found at Sandy Point, Strait of Magellan. My specimen, taken by the Hassler Expedition, was kindly donated by the Museum of Comparative Zoology.

A fourth species, *Urechis novae-zelandiae* (Dendy), awaits detailed investigation (Dendy, 1898; Poche, 1920).

Dr. Carlos E. Porter, of Santiago, Chile, has called attention (*in litt.*) to the name *Pinuca edulis* Claudio Gay (1854, p. 475). Dr. W. L. Schmitt, to whom Dr. Porter sent the information, had photographs made of the five pages covering the section on "Sipunculides" in the "Historia . . . de Chile." Four of these are pages 53–56 of volume 3 published in 1849 and list *Sipunculus lagena* and *S. cylindricus*. *Pinuca edulis* is described in supplementary volume 8, published in 1854, as follows:

Añade tomo III, pág 56. *Pinuca edulis*. Por haber perdido los ejemplares que teníamos de este singular Sipunculiano, es preciso á lo menos señalarlo á la atencion de los naturalistas y viajeros. Segun nuestro diario es de un blanco pardusco súcio y tiene de dos á tres pulgadas de largo y como una de ancho. Su cuerpo es subcilíndrico, ligeramente hinchado en el medio y adelgazado en ambas puntas, siendo la anterior mucho mas obtusa que la posterior. El cuero es grueso, coriáceo, un tanto arrugado en al traves, ló que proviene de la reunion de una infinidad de pentitos mas ó menos prominentes. La boca es pequeña, arugada, rodeada, á poca distancia, de muy pequeños aguijones apenas visibles, subretractiles y dispuestos en círculo. El ano se halla á la otra extremidad y es bastante grande, liso, circular y un poco hendido. Un diseño hecho en el lugar, señala hácia el medio una reunion de pequeños cuerpos dispuestos en una banda circular de una línea poco mas ó menos de ancho.

Este animal que los habitantes comen cocido en la brasa despues de haberle quitado las dos extremidades, se halla en las arenas de la isla de Chiloe cerca de Castro, etc. En mi diario hallo notado que hace el pasaje de los Priapos á los Sipunculos.

Without specimens from Chiloé Island it is not possible to determine whether *Pinuca edulis* is the same animal as *Urechis chilensis*, which has not been reported so far north. If *Pinuca* is an *Urechis* it is

obvious that Gay has the mouth and anus confused; and the length of 2 or 3 inches is small for the average size. There are other discrepancies. In a *Urechis* 3 inches long, the anal setae are not "scarcely visible" but are conspicuous; no mention is made of the prominent anterior setae; no specimen of *Urechis* displays "hácia el medio una reunion de pequeños cuerpos dispuestos en una banda circular de una línea poco ó menos de ancho," whether "medio" refers to the body or to the anus (mouth), which just precedes this sentence in the description.

The curious respiratory mechanism of *Urechis*, in connection with the loss of its blood vessels and the complexity of its blood physiology, relegates the genus to a very isolated position. Not less important is the behavior pattern whereby the requirements of respiration and food are beautifully met and coordinated. At every point specialization of habit is matched by structural and physiological adjustment of the most delicate and efficient description. Along with this specialization and complexity is an amazing viability best expressed by the term "tough."<sup>23</sup>

All signs point to *Urechis* as being the last of a very ancient stock, one that may have flowered into many species during Paleozoic times. It belongs to the honorable company of *Lingula* and those other aristocrats sometimes referred to as "living fossils."

#### URECHIS CAUPO Fisher and MacGinitie

FIGURES 17-19; PLATES 33-35; PLATE 36, FIGURES 2, 4; PLATE 37

*Echiurus* sp. JOHNSON and SNOOK, 1927, p. 178, fig. 153.

*Urechis caupo* FISHER and MACGINITIE, 1928a, p. 200, pl. 9, figs. 1-6; 1928b, p. 204, figs. 1-3, pl. 10.—BAUMBERGER and MICHAELIS, 1931, p. 417.—REDFIELD and FLORKIN, 1931, p. 185.—HALL, 1931, p. 400.—SATO, 1931, p. 178.—NEWBY, 1932, p. 387; 1940; 1941, p. 303.—MACGINITIE, 1935a, p. 341; 1935b, p. 602; 1935c, p. 483; 1938, p. 208.

*Description.*—The species reaches a large size. One specimen collected by G. E. MacGinitie at Humboldt Bay, Calif., measures 470 mm. long by 55 mm. thick. The largest specimen from Elkhorn Slough, Monterey Bay, Calif., was 500 mm. long when fully relaxed in anesthesia, but after preservation it shrank to 375 mm. in length by 35 mm. in diameter. These were undoubtedly very old individuals. Average specimens are 150 to 180 mm. long.

The surface of the body is traversed by fine irregular channels giving a rugose appearance, which is most pronounced in the head region anterior to the zone of slime glands. The latter, a sort of clitellum, is usually distinguishable by the circular trend of its fine furrows. Its anterior border coincides roughly with the second pair of nephridia,

<sup>23</sup> See Redfield and Florkin, 1931; Baumberger and Michaelis, 1931; Hall, 1931; MacGinitie, 1935a, 1935c; Newby, 1940, 1941; Fisher and MacGinitie, 1928a.



while the posterior border is spaced behind the third pair a distance about equal to interval between second and third pairs. This zone contains the slime-net glands. "Three to 10 or even more glands are located on the outer surface and in the outer part of the sides of the papillae. These glands develop from the surface epithelium and are formed by an invagination of this layer of cells and the outlying cuticle. The gland cells develop numerous terminal cones which penetrate into the cuticle of the duct (formed by invagination). During the secretion of any one slime-net only about one-eighth of the gland cells are active. In these cells the terminal cones perforate the cuticle and open into the duct as minute tubules from which the fibrous secretion which forms the slime-net is discharged. The net

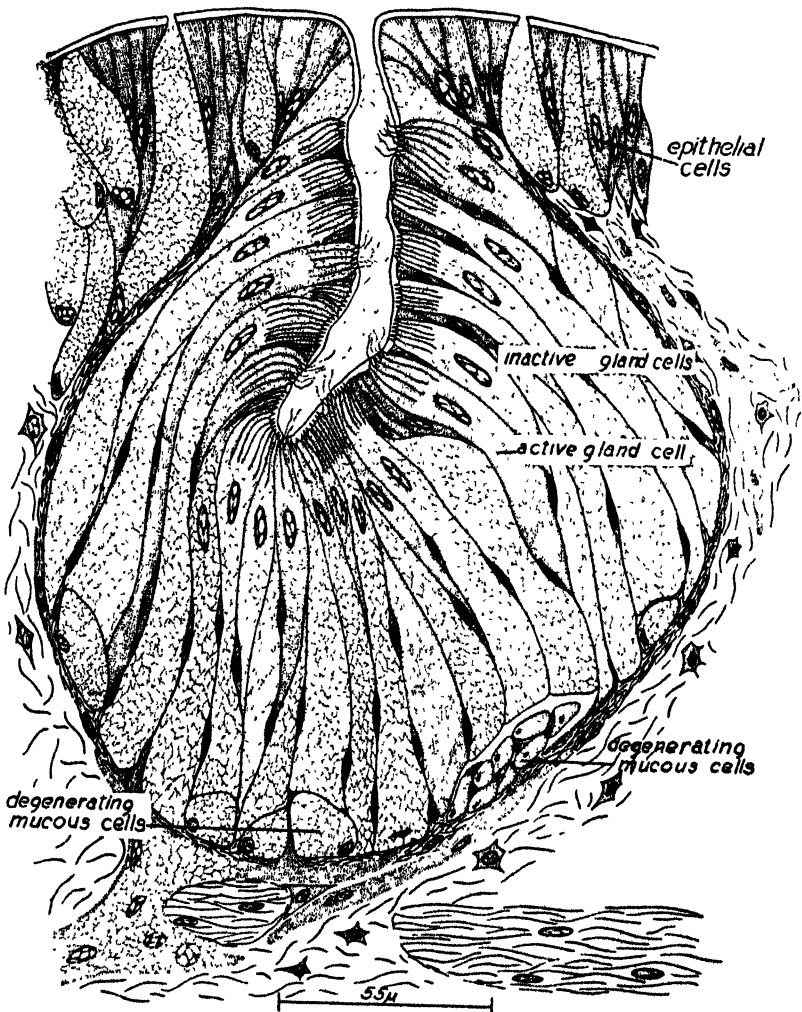


FIGURE 17.—*Urechis caupo* Fisher and MacGintie: A vertical section of a mature slime-net gland taken while actively secreting; drawing by W. W. Newby (1941).

itself is probably fibrous in nature, although this has not been demonstrated. [Figs. 17, 18.]

"The body wall consists of the cuticle, the surface epithelium or epidermis, and the underlying connective tissue called the cutis (Jameson, 1899, p. 572) or corium (Seitz, 1907, p. 326). These three layers constitute the skin. Beneath them are the outer circular, the longitudinal, the inner circular muscle layers and the parietal peritoneum."<sup>24</sup>

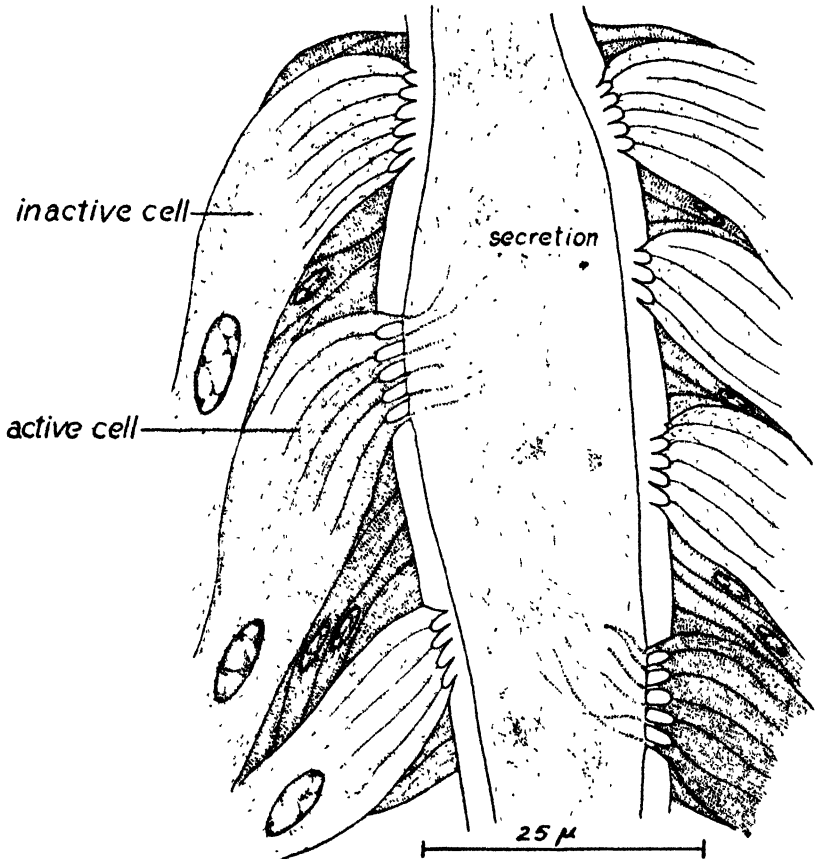


FIGURE 18.—*Urechis caupo* Fisher and MacGinitie: A vertical section of the middle part of a slime-net gland taken while actively secreting; drawing by W. W. Newby (1941).

Anterior setae terminally tapered, sharp, curved, situated, in large specimens, 3 to 5 mm. back of the groove leading to mouth and about the same distance apart. They are metallic yellow, brownish at tip, 8.5 to 10.5 mm. long. The flattened, curved exerted portion is more tapered and sharper than in *chilensis*. A strong interbasal muscle is

<sup>24</sup> Newby, 1941, pp. 304, 315; figs. 1-10. Dr. Newby has subjected the slime glands to a thorough histological study. He has kindly contributed the original drawings of figures 17 and 18, which are from the above paper.

present, and numerous somewhat variable muscles radiate from the coelomic end. Inside the seta sac a short substitute seta is often present close beside the functional one.

Anal setae curved terminally, sharp, 10 or 11 in number, and the dorsal are longer (8.5 mm.) than the ventral (7.3 mm.). The dorsal are the only ones used to any extent in cleaning out the burrow. When digging, the posterior end of the body is bent sharply forward, underneath, so that the ventral setae touch the ventral surface of the worm, while the strongly exerted dorsal bristles scrape the mud backward as the body is again straightened. This habit helps to explain the absence of a midventral seta, there being a broader gap at that point. The anus is eccentric to the circle of setae, being nearer to the ventral side (center of anus 6 or 6.5 mm. from dorsal setae and 4 or 4.5 mm. from the ventral). All bristles show conspicuous cross-banding.

There are three pairs of nephridia varying greatly in size according to degree of distension with eggs or sperm. In one specimen examined the posterior tubes were 150 mm. long and 10 mm. in diameter, reaching two-thirds the total length of animal. The anterior pair is situated close to the setae. Rarely, one nephridium of this pair is missing. The nephrostome is on the anterior side at the base and the grooved ciliated lips are very long and spirally coiled. MacGinitie (1935a) has shown that the superficial groove, V-shape in section in the male and more C-shape in the female, communicates by a slit along its bottom with what is virtually an almost closed duct or tube underneath. In both upper and deeper parts of groove the cilia beat toward the nephridium while on the outside of the lips, bordering the superficial groove, they carry materials in the opposite direction and incidentally help in the circulation of the coelomic fluid and contained blood cells. "As the eggs, blood cells, and other coelomic materials pass along the outside of the thread the eggs are caught in the external portion of the groove, are fed into the inner channel and then proceed to the opening leading into the storage reservoir [nephridium]. They are carried toward the reservoir at the approximate rate of 7 spirals per minute. Thus the eggs are separated from all other coelomic materials. As the eggs pass through the slit between the external portion of the groove to the inner channel, they are under considerable pressure. They enter as a wedge, then become disc-shaped in the slit, and finally round out in the inner channel. Only mature eggs with indentations are collected in this way. As the eggs pass along the inner groove toward the storage organ they become oriented with the convex surface of one egg pushed into the indentation of the egg ahead, thus forming a compact chain. Blood cells (which range from 0.014 to 0.02 mm. in diameter) and immature egg cells pass along the collecting threads (i. e.,

the spiral lips) without lodging in the external groove. Sperm is collected in the outer groove of male collecting threads, fed into the inner groove, and carried to the storage organ."<sup>25</sup>

There is no permanent gonad. "Sex cells in all stages of development, from very immature ones to those which appear to be fully mature are found in the coelomic fluid at all times of the year. In the case of the male, the apparently mature, free-floating sex cells are known to be functional." (MacGinitie, 1935c, p. 485.) "I have examined a male collected in winter as well as several specimens of both sexes collected in the summer and in these I could establish neither qualitative nor quantitative differences in the sex cells at the two seasons. Furthermore, in neither season did I find mitotic figures in any area of the peritoneum nor could I establish any evidence of division by any of the cells which were free in the coelom. Thus there is no evidence in regard to the origin of the sex cells in *Urechis*." (Newby, 1940, p. 7.)

MacGinitie (1935a, p. 342) estimates that there are nearly 3 billion sperms present in the nephridia of an average-sized male and over 6 million eggs in an equal-sized female. The eggs are 0.115 to 0.12 mm. in diameter according to MacGinitie (southern California specimens). C. V. Taylor measured 303 from the Monterey Bay region and found them to range between 0.123 and 0.144 mm. in diameter.<sup>26</sup> The egg is very clear, with a large nucleus, containing a nucleolus 0.012 to 0.016 mm. in diameter.

The anal vesicles, contracted, have a cauliflower surface beset with minute ciliated funnels. They empty, ventrally, into the posterior part of the cloaca.

In addition to abundant sex cells, the coelomic fluid is filled with nucleated red or brown blood corpuscles subcircular in shape and upward of 0.035 mm. in diameter, together with very numerous amoeboid cells, yellowish when aggregated. "The color of the blood varies from the purest oxyhemoglobin red to the darkest brown-black or a blacklike Chinese ink, even after complete saturation with oxygen. The red color is due to hemoglobin homogeneously distributed within the blood cells. Whenever the color is brown, besides this hemoglobin there is another granular pigment of brown color within the cells which will be proved to be hematin. Red blood was encountered in some few of the smallest individuals and in some of the very largest sex-mature females. The majority of the individuals, of medium size, contained brown or brown-black blood." (Baumberger and Michaelis, 1931, p. 417.)

<sup>25</sup> MacGinitie, 1935a, p. 346. A careful paper based upon observation of living material and the only one describing the behavior of the nephridial appendages.

<sup>26</sup> *Physiological Zoology*, vol. 4, p. 430, 1931.

**ALIMENTARY CANAL.**<sup>27</sup>—As indicated in the family and generic diagnoses, the most characteristic features of the alimentary tract are the extremely long presiphonal foregut, with its very extended gizzard segment, and the "hind-gut" modified to act as a respiratory organ. These features are closely similar in the three species, all of which I have dissected. The apparent differences in the published figures are due to limitations of material or faulty observation. In plate 34, figure 1, the greater part of the siphonal and part of the postsiphonal gut have been removed. A very contracted specimen was used owing to limitations of plate. Here it is obvious that the foregut is considerably longer than the body. In a well-expanded preserved specimen, 300 mm. long, the pharynx is 30 mm. long; esophagus 40 mm.; crop 85 mm.; gizzard 85 mm.; stomach 50 mm.; total 310 mm. In an expanded specimen the distance between the position of the stomach and anus may equal nearly one-third body length and the muscular mesentery may be, as in the specimen under discussion, 35 mm. long. The posterior attachment of this mesentery is indicated also in plate 36, figure 4, *M*<sup>2</sup>.

The pharyngeal lining is thrown into very coarse longitudinal folds, which really begin on the ventral side of proboscis and run directly to the esophagus, diminishing in size. In the esophagus the much smaller ridges are cross cut by deep narrow channels, which divide them into rings of oblong verrucae, giving the exterior a ringed appearance. The esophagus is definitely begun at the last of the dorsolateral mesenteries of pharynx (pl. 34, fig. 2, 15). In this figure an attempt is made to show the muscular mesenteries of the pharynx by a view looking forward into the head region from just back of the first pair of nephridia. The pharynx has been pulled upward by the contraction of these dorsal and dorsolateral mesenteries 1-7 (left side). The ventral mesenteries (14) are the least variable. Muscle 13 (paired) is not connected with the alimentary canal but is attached below to body wall in front of the seta, and above, dorso-laterally. All these muscular mesenteries are characteristic of the genus and on direct comparison appear to be more robust in *chilensis* except 13, which is better developed in *caupo*.

The crop (crop 1 of Seitz) is subtended by a strongly muscular mesentery not attached to body wall. The posterior part of esophagus (pl. 34, fig. 1, X) loses its ringed appearance, the mucosa having deep, fine, longitudinal folds. In the crop the mucosa is again regularly verrucose, but of finer texture than in esophagus. In the gizzard the mucosa is thrown into strong ring folds, formed by the annulate muscles of gizzard wall, conspicuous superficially. The

<sup>27</sup> Embleton, 1900, pl. 8, gives some figures of the histology of alimentary canal of *U. uncinatus*; Seitz, 1907, pl. 31, for *U. chilensis*.

crop and gizzard of *chilensis* by direct comparison are definitely longer than in *caupo* by about 25 percent.

The stomach (crop 2 of Seitz) corresponds to that of *Thalassema*, and the mucosa has about 12 distinct longiseries of compressed verrucae. Externally the stomach has the longitudinal zonation characteristic of *Thalassema* and allies. It ends abruptly at the beginning of the much wider midgut with its ciliated groove. About 3 mm. from end of stomach the siphon begins, while the ciliated groove continues adjacent to it, along the inside of intestine (pl. 35, fig. 5). A strong muscular mesentery subtends the stomach and is attached posteriorly a little to left of nerve cord ( $M^2$ ). In *chilensis* the siphon begins 9 mm. from end of stomach as compared to 2.5–3 mm. in *caupo*.

The course of the intestine in a fully expanded specimen is shown in plate 35, figure 1. The anterior and posterior portions of the body are omitted. Plate 36, figure 4, shows the cloacal region of the same specimen. It will be seen that the siphonal part of the intestine is very long and includes two anterior and two posterior bends. Three segments of the gut are attached by muscular mesenteries on the right side of body and three (including the big "hind-gut") are attached on the left side. The foregut is not attached to body wall except by the strong pharyngeal mesenteries and the mesentery of the stomach ( $M^2$ ). In this figure the breadth is accentuated because the body wall is pinned out flat. The mesenteries of siphonal gut farthest to right are attached about halfway between midventral and middorsal lines.

The postsiphonal "small intestine" is rather short and is anchored by heavier mesenteries than are found on the siphonal portion anterior to the last loop. The "hind-gut," used as a respiratory organ, varies in dilation and consequent thickness of wall in different specimens. The wall is usually thin and translucent. It is firmly anchored along its entire length on the left side of the nerve cord. On plate 36, figures 1–3, I have shown the attachment of the anterior end of the "hind-gut" in the three species. Unless the single specimen of *chilensis* available for dissection is abnormal, there is considerable difference between it and *caupo*.

The cloaca is probably normally elongate as shown in plate 36, figure 4. It is here shown opened for the entire length. The mucosa of the posterior third is deeply furrowed longitudinally, and in this part, on the ventral side, are the openings of the two anal vesicles. The fecal pellets which sometimes crowd the portion of small intestine shown in plate 34, figure 1, are cylindrical with rounded ends (pl. 35, fig. 6).

The fresh colors of the viscera in an anesthetized specimen are: Foregut, pale flesh or skin color; anterior third of midgut pale gray-green mottled with brown; middle third, mottled yellow and dull

gray-green; posterior third pale gray-green; siphon, pale jade green; respiratory gut, translucent raw sienna.

*Type*.—U.S.N.M. No. 19616.

*Type locality*.—Elkhorn Slough, an estuary of Monterey Bay, Calif.; shallow water, muddy sand.

*Distribution*.—CALIFORNIA: Humboldt Bay, Tomales Bay, Monterey Bay (see note below), Morro Bay, Newport Bay. With one exception all specimens have been found living under essentially estuarial conditions; that is, in quiet bays or sloughs in sandy mud. As a rule the openings of the burrows are under water at low tide, but are sometimes uncovered. However, in June 1923 I found one good-sized specimen in a bucket holding flounders and other fish caught in essentially open sea conditions near the Hopkins Marine Station, Pacific Grove, Calif. This record points to the probable occurrence of the species at moderate depths almost anywhere off the coast of California where mud of the proper consistency for permanent tunnels is present.<sup>28</sup>

*History*.—The first specimens of which I have any knowledge were collected in 1903 by C. S. Thompson, at Morro Bay, Calif., and brought to Stanford University. Some of these, in a good state of preservation, are still in the museum there. In 1920 I found one specimen in Elkhorn Slough, Monterey Bay, where a few years later Dr. Myrtle Johnson collected the examples from which the figures in "Seashore Animals of the Pacific Coast" were drawn. In 1923 a specimen was brought in by flounder fishermen from the sea bottom off the Hopkins Marine Station. It was not until 1926 and 1927, however, that the animal was studied. In connection with an ecological exploration of Elkhorn Slough, Prof. G. E. MacGinitie, then a graduate student working at the Hopkins Marine Station, found them in quantity. By means of narrow aquaria filled with mud ("limoria") and glass-tube facsimiles of the actual burrows, he was able to observe living animals under essentially normal conditions, for *Urechis* seems to be insensible to light. Every important fact in the ecology of *Urechis* has been discovered by Professor MacGinitie.<sup>29</sup>

*Habitat*.—The first field studies were made at Elkhorn Slough, a shallow estuary, tributary to Monterey Bay, where the water, although slightly warmer than that of the ocean (which here varies from 49° to 57° F.), has practically the same salinity, there being usually a free interchange with each tide. In this inlet dwell a considerable variety of bivalves, some of which are much sought for food. There are two very interesting decapods, *Callinassa californiensis* Dana and *Upogebia pugettensis* (Dana), which, like *Urechis*, construct

<sup>28</sup> Dr. Earle H. Myers tells me he has found *Urechis* in the stomach of dogfish caught northwest of San Francisco Bay entrance (Golden Gate).

<sup>29</sup> Fisher and MacGinitie, 1928b; MacGinitie, 1935b, pp. 682-686, 688, 715, 717; 1938, p. 208.

tunnels in the mud and conduct a more or less permanent ménage. The mud teems with annelids such as *Lumbrinereis*, and there are literally acres that have a greenish tinge from the tentacles of *Phoronopsis viridis* Hilton. *Zostera* grows in permanent patches and supports a characteristic association of animals. At favorable times wide expanses support a growth of green *Enteromorpha* which, either fresh or decayed, is an important food element, since the bulk of animal life consists of detritus feeders.

At low water broad areas are left bare, but *Urechis* usually excavates its home where the entrances are not exposed at lowest tide. A few places were found where they are exposed at lowest tide.

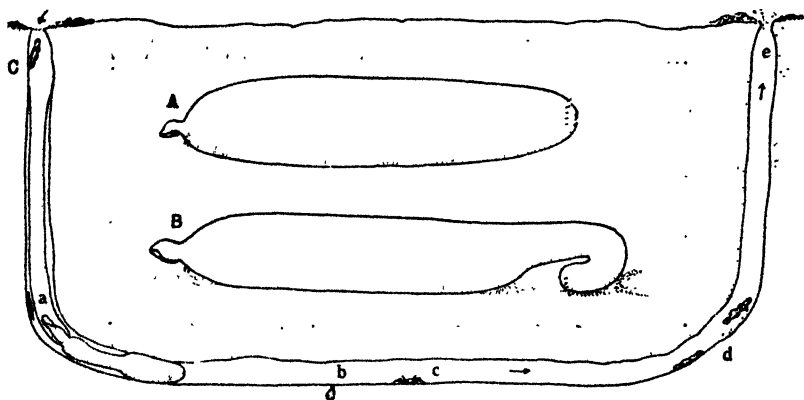


FIGURE 19.—A, *Urechis caupo* Fisher and MacGinitie, in resting posture. B, Position assumed while digging with anal setae. C, Plan of *Urechis* tunnel, the worm *in situ* pumping water through the slime-tube. Water enters at C, where there are two *Clevelandia* (one outside); at a, *Hesperonoe* lies in wait to feed on tube when it shall be swallowed; b, the tiny clam *Cryptomya californica*; c, *Scleroplax*; d, *Clevelandia* creating disturbance; e, eruption of mud cloud on ventilating current; castings around exit.

The tunnel (fig. 19, C), never carried very deep, has two entrances and is in the form of a widely expanded U, of which the uprights are nearly perpendicular and the bottom horizontal. The apertures are small, being about one-third the diameter of the tunnel itself. Around one of the openings there is a considerable quantity of castings. The greatest distance between entrances measured 38 inches, the shortest 16 inches. Twenty-seven was the average for many measurements. The distance apart of the two entrances depends upon the size of the animal but not proportionately so, for small specimens have more extensive burrows for their size than larger ones. The largest specimen obtained was 19.5 inches long when relaxed in anesthesia, and the smallest was 1 inch.

The burrows have a permanent aspect and none of those continually observed was found changed except that occasionally one had a new entrance. The animals grow very slowly, and so the enlargements need



be made only at infrequent intervals and then only by widening the U and extending one of the entrances.

*Locomotion.*—A *Urechis* can move along a smooth surface in much the same manner as an earthworm. It elongates the anterior part of the body and then forces forward the viscera and the water contained in the respiratory gut by contracting the posterior region and relaxing the anterior. When most of the body weight is in the anterior end the posterior portion is drawn up. These movements are repeated as the animal proceeds. Its method of locomotion within the burrow is quite similar except that the animal has the added advantage of being able to wedge the anterior portion against the sides of the burrow. Its rapidity of locomotion approximates that of an earthworm. It can move considerably faster when in the burrow than when out of it, and it can move backward nearly as fast as forward.

*Digging.*—When digging a tunnel *Urechis* forces its proboscis into the mud and works out a hole until the body can be drawn into it. This process is continued until the worm completes a U-shaped tunnel open to the surface at both ends, so that a supply of fresh water may be pumped through the tube by peristaltic movements of the body. Then the bore of the tunnel is enlarged by scraping material from the sides by means of the anterior setae, working it backward with the anal setae, and finally blowing it out the "back door" by a blast of accumulated respiration water from the hind-gut. To loosen sand from the sides of the burrow, the oral setae are protruded, then drawn backward through the sandy mud. This digging is done on all sides of the burrow as the animal can rotate its body at will. The setae are shed occasionally and renewed.

The use of the anal setae, which form a ring of 10 or 11 a short distance from the anus, is highly characteristic and was carefully observed. The sharp retractile bristles curve forward. The mid-ventral seta is lacking, and the pair on each side are distinctly shorter than the four or five dorsal setae. When a certain amount of loosened debris accumulates from the activities of the anterior bristles, *Urechis* crawls over it and forces it backward, in one of two ways: either by blowing the sand along with anal-water jets, augmented by the vigorous ventilating stream of the tube, or by turning under the posterior end of the body and then vigorously straightening it (fig. 19, B). The loosened material is shoved along the tunnel, whereupon the anal jet and ventilation current propel the finer detritus still farther. The animal backs up and repeats the process. When the posterior end is folded under, the dorsal setae are strongly everted and their forward curvature favors efficient scraping. The ventral setae (now dorsal in position) are against the ventral body wall and do not function. A reason for the smaller ventral setae (and the absence of the mid-

ventral seta) is now apparent, if we have faith in the efficacy of use and nonuse in determining the relative size of similar organs.

Castings are sometimes ejected from the burrow by this flipping of the posterior end of the body (which can be admirably imitated with the forefinger), but usually only by water currents. Castings are allowed to accumulate and then are ejected in quantity from one entrance. When digging downhill the animal shoves the soil along the body and then out by backing up the burrow, forcing the sand out the last inch or two by water currents. The opening then resembles a miniature volcano with fine dark sand spouting out and the roily water trailing off from the crater like smoke. A major convulsion will carry out fragments of shells 2 or 3 mm. in section. Larger objects are avoided or allowed to fall toward the lower part of the burrow where they are buried. Doubling the velocity of water increases its carrying efficiency directly as the sixth power. The narrowed mouth of the tunnel undoubtedly aids in increasing the force of these "volcanic" manifestations and hence their efficiency in removing sizable debris.

Once *Urechis* is settled in a permanent home its daily activities consist of respiratory movements, obtaining food, cleaning the burrow, and resting.

*Respiratory movements.*—There are two separate movements concerned with the respiration of *Urechis*: (1) The peristaltic movements along the body which pump fresh water into the tunnel and move that within respiratory chamber of the intestine; (2) the inhalations and exhalations, through the anus, for which the muscular cloacal chamber, resembling that of a holothurian, supplies the chief motive power.

The inhalations are from 1 to upward of 30 in succession (without an exhalation). Exhalation is usually a single discharge although infrequently a rest may occur during a period of exhalation. The rate of breathing is not uniform. For instance, 2 inspirations covering 25 seconds were followed by an expiration period of 10 seconds, while in another instance 7 inspirations occupied 25 seconds, the expiration 10; 24 inspirations occupied 70 seconds, the single expiration 50; 30 inspirations occupied 90 seconds, the expirations only 25. Inspirations fewer than 12 predominate in a total of 11 cycles timed. These times were taken on a specimen lying in a pan of water. In its natural environment *Urechis* breathes more slowly, but with the same irregularity.

The peristaltic movements of the body which serve to propel water through the tube are even more erratic. The wave, which expands the body to fill the burrow, begins at the base of the proboscis and passes along the body at varying rates for different waves or even the same wave in different parts of the body. As one wave arrives at the

posterior portion of the body a new one begins at the anterior end. *Urechis* is normally always in control of the water and senses anything which may attempt to pass through the burrow.

*Feeding.*—The unique method employed by *Urechis* to gather nourishment is generic and furnishes a striking example of the coordination of adaptive structure and behavior.

A short distance back of the oral setae is a zone of compound mucous glands, which form a sort of clitellum very faintly differentiated externally by the ringlike arrangement of the low rugosities of the skin. These glands are specializations of the simpler and more numerous multicellular flask-form mucous glands of the integument. The slime-net or girdle glands, as they have been called, secrete a fairly long transparent mucous tube, or funnel, whose upper, open end is fastened near the mouth of the tunnel while the lower remains attached to the clitellum. This strains from the ventilating, or respiratory currents, all minute particles as the water flows through and when sufficiently loaded the tube is swallowed. The process is repeated as long as the animal feeds. *Urechis* readily adopts a glass substitute for its normal burrow so that feeding reactions can be closely followed (pl. 37, fig. 1).

Just before starting a tube, the body is constricted at the clitellum. This region is then expanded until it presses firmly against the sides of the burrow (usually near the mouth, but sometimes in the horizontal portion) with which it remains in contact for about 2 seconds. During the spinning process, which occupies only a few minutes, the constricted portion of the body anterior to the clitellum (whence the slime is issuing) undergoes a curious spiral peristalsis (pl. 37, fig. 5) easily detected by watching the nerve cord, which shows through the pink body wall, while back of the clitellum the normal respiratory, or pumping, peristalsis is taking place.

The tubes vary in length from about 2 to 8 inches without apparent reason. As the tube lengthens *Urechis* backs down the tunnel, and on completion the spiral peristalsis anterior to the clitellum ceases, being replaced by a faint normal peristalsis, the main wave starting just back of the attachment of slime tube to the body. These normal ventilating reactions are kept up until the animal, apparently sensing the blocking of the water current by the clogging of the mucus with detritus, slips the tube forward "over its head." In doing this it deftly catches the hind edge of the tube by expanding the proboscis and bending it backward, collarwise, against the inflated nuchal region, until the muscular pharynx is able to pick up and suck in a portion of the margin (pl. 37, fig. 7). When diatom culture or detritus is introduced with a pipette the slime tube is soon swallowed; but if unmolested, *Urechis* may continue pumping for an hour before the tube is clogged.

Usually only a few minutes are required for swallowing the tube, but the time depends upon length of tube and the amount of detritus intercepted. When the tube has been swallowed up to the point of attachment the animal makes a movement to release it from the sides of the burrow similar to the reaction while digging with oral setae.

The food funnel is porous to liquid but will intercept the smallest particles. Phenol red passes through everywhere, but no carmine particles ever do. Under the microscope no openings can be detected, but particles approaching a micron in diameter are lodged in the mucus.

When first secreted the tube is perfectly transparent, but as it collects detritus it becomes gray and its outlines are easily seen. Peristalsis becomes more energetic as the tube-wall fills.

When spinning the tube or lying at its lower end pumping water through it, *Urechis* is very sensitive to disturbances. If water is injected into the mouth of the tunnel, the animal immediately ceases movement and remains perfectly still for a minute, then slowly resumes peristalsis. If the disturbance is too great, it will drop out of the tube and retreat toward the center of the burrow, returning later to eat the slime tube. While it is lying at the end of a completed slime tube any slight disturbance such as the introduction of a little mud or fresh clean meat will cause *Urechis* at once to pass the tube forward and begin swallowing. No large particles are ingested. They are rejected as the tube is being swallowed.

*Urechis* feeds to some extent, although not very efficiently, when lying without its burrow in an aquarium. In such a position it will swallow sediment from the bottom of the aquarium gathering it with the proboscis.

*Resting*.—After a period of feeding *Urechis* goes to the horizontal portion of the burrow, contracts its body so that it fits the tunnel snugly, and lies in a state of suspended activity during which even respiration ceases. These rests may last for an hour or more, but the long rests are always preceded by one or more short rests, which last 4 to 8 minutes, and between which respiratory water is expelled and more taken in (fig. 19, A).

*Commensals* (pl. 37, figs. 1-3).—*Urechis* has three permanent commensals: A polynoid annelid, *Hesperonoë adventor* (Skogsberg), and 2 pinnotherid crabs, *Scleroplax granulata* Rathbun and *Pinnixa franciscana* Rathbun. Sometimes all three are found in the same burrow, but usually only a *Hesperonoë* and either a *Scleroplax* or a *Pinnixa*. In addition, the little *Cryptomya californica* (Conrad) projects its siphons into the burrow to make use of the water in the burrow for its source of food and oxygen. The goby *Clevelandia ios* (Jordan and Gilbert) uses the burrow as a retreat rather than a residence, as the little fish freely forages outside, returning when alarmed

or when the entrance is left exposed by low tide. On such occasions one to five gobies may be taken from the upper part of the tunnel. A goby left at the laboratory for several weeks in a glass burrow appeared contented. It would pass from one end to the other, wriggling past the *Urechis* as if accustomed to doing so. At Newport Bay a pair of either *Betaeus longidactylus* Lockington or *Crangon* [*Alphaeus*] *californiensis* (Holmes) have been found permanently established in the burrows of *Urechis*. The former is also recorded from Elkhorn Slough from *Urechis* burrows (MacGinitie, 1935b, p. 706).

*Hesperonoë adventor*, which ranges in length when alive from 15 to 50 mm., is commensal with *Urechis* throughout its range from Humboldt Bay to Newport Bay and normally is not found outside the burrows. The food of *Hesperonoë* consists of particles rejected by *Urechis* when swallowing its slime tube. These particles consist of either living or dead animals which wash down the burrow with the current and become entrapped in the slime-net. Sometimes when *Urechis* is swallowing its slime tube the polynoid will crawl forward and eat part of the tube and contents. It is very aggressive toward intruders within the burrow other than the commensal crabs. Only one *Hesperonoë* occurs within each burrow, and if another enters the two will fight until one is killed or driven from the burrow. Other annelid worms which may find their way into the burrow are speedily dispatched (by means of the short eversible toothed proboscis) and devoured.

*Hesperonoë* rests with its dorsal surface in contact with the body of *Urechis*, moving along the burrow with the latter by making little short runs as the peristaltic movement of the body of *Urechis* passes by. It always faces in the same direction as *Urechis*, and when the latter turns in its burrow the annelid quickly does likewise. *Hesperonoë* is also commensal in *Echiurus* tunnels.

*Scleroplax* ranges from 3 to 13 mm. across the carapace and is commensal also in the tubes of *Callianassa californiensis* and *Upogebia pugettensis*. It rests facing the side of the burrow, the chelipeds turned up in front and the last pair of legs raised behind. In this posture it can travel sidewise along the tube much faster than its host. Its food consists of particles which wash into the burrows or are uncovered by the hosts. *Pinnixa franciscana* screens detritus by means of its second maxillipeds, and it will also feed on particles of worms, clams, etc. *Scleroplax* has never been observed screening plankton. As many as six *Scleroplax* have been taken from one *Urechis* burrow. A male and a female are often found together or two females. In one instance an ovigerous female was found with an ovigerous *Pinnixa*, and in another burrow a male *Scleroplax* and a male *Pinnixa*.

*Enemies.*—*Urechis* probably attains a ripe old age. Five specimens of different size, kept in mud in the laboratory for over a year, appear not to have grown. However, as their food is principally detritus, and as natural conditions are necessary to keep this stirred up in order that any quantity may be drawn into the slime net, laboratory growth tests are not convincing. Yet what might be termed the settled habits of the creature and the scarcity of very small specimens point strongly toward longevity. The only animal known to prey upon them is the sting ray (*Myliobatus californicus* Gill), which can dig out an occasional *Urechis*. In the ocean, however, small worms are possibly eaten by flatfishes, which regularly feed upon *Listriolobus pelodes*. As already noted, Dr. Earle H. Myers found *Urechis* in the stomach of small sharks.

The period of mortality probably comes during the larval stage. The small goby (*Clevelandia ios*) is extremely numerous, darting here and there, for any moving particles. These fish range from half an inch to 1½ inches in length and often devour objects so small as to be invisible to the observer. On one occasion 400 of these little gobies were netted from a hole, 3 by 6 feet, left by clam diggers. In addition the tiny *Urechis* must run the gauntlet of a host of small predaceous crustaceans, annelids, nemerteans, and mollusks which forage on the surface and in the upper layers of mud. Once established in a burrow *Urechis* is relatively safe.

*Parasite.*—I have found rather numerous cestode larvae 0.25–0.32 mm. long in the proximal end of the siphon where they perhaps cause the hernialike swellings of the siphon wall (pl. 35, figs. 4, 4a, 5). Probably the adult is to be found in the sting ray.

*Spawning.*—Stored sex products are found in the nephridia throughout the year. MacGinitie (1938, p. 208) states that normal spawning takes place during a short season, usually in spring or at the beginning of summer as the temperature of the water rises. One male which he kept in the laboratory for two or three years spawned on May 24 and 25. Just prior to spawning the worm came nearly to the opening of the glass tube which served as a habitation. Three welts were thrown around the body so that the circular creases were just anterior to each of the three pairs of gonopores, and the gonopores themselves were somewhat protruded and turned toward the anterior end of the body, and, therefore, toward the opening of the tube. The gonopores became quite conspicuous; this was followed by several retching movements, as if the animal were attempting to regurgitate, and then sperm issued in a stream from each gonopore. When the sperm ceased to be expelled, the animal underwent violent peristalsis, the waves running from the posterior to the anterior end, causing the sperm to pour out of the glass tube. The retching, followed by the violent antiperistalsis, was performed three distinct times. On both days after spawning the

worm went back to the bottom of the tube, pumped vigorously for some time, and then resumed feeding. During spawning the body of the worm was much more elongated than normally. The spawning on May 24 occurred at 4:30 p. m., that on the following days at 9:20 a. m. Although the nephridia were emptied the first day of spawning, the movements and procedure on the second day were the same as for the first spawning, but very little sperm was discharged.

The embryology of *Urechis caupo*, outside the scope of this paper, has been thoroughly described and figured by Dr. W. W. Newby (1940). In this paper, which merits the highest praise, the relation of the Echiuroidea to other phyla is fully discussed.

### ADDENDUM

In 1942 Dr. Sixten Bock published an important memoir "On the Structure and Affinities of '*Thalassema*' *lankesteri* Herdman and the Classification of the Group Echiuroidea." Owing to delays occasioned by the war, it has been possible to incorporate only the most important systematic data in the foregoing report, such as the new genera *Ikedosoma* and *Mazmülleria*. It is to be hoped that Dr. Bock will continue his fundamental work and will be able to revise the genus *Ochetostoma*, badly in need of an overhauling.

As Dr. Bock's scheme of classification differs from mine, it is given herewith in skeleton form:

#### Class ECHIUROIDEA [of phylum Annelida]

##### I. Order ECHIUROINEA, nov.

1. Family Echiuridae Baird, 1868. Genera: *Echiurus* and *Urechis*.
2. Family Thalassematidae, nov.
  - a. Subfamily Ikedinae, nov. Genus: *Ikeda*.
  - b. Subfamily Thalassematinae, nov. Genera: *Thalassema*, *Ochetostoma* (incl. *Listriolobus*), *Ikedosoma*, *Arhynchite*.
3. Family Bonelliidae Baird, 1868. Genera: *Mazmülleria*, *Acanthohamingia*, *Archibonellia*, *Hamingia*, *Parabonellia*, *Protobonellia*, *Pseudobonellia*, *Bonellia*

##### II. Order SACCOSOMATINEA, nov.

1. Family Saccosomatidae Theel, 1906. Genus: *Saccosoma*.

##### III. Order POEOBIINEA, nov.

1. Family Poeobiidae Heath, 1930. Genus: *Poeobius*.

"The two latter orders comprise each a single species and they must be regarded as very aberrant Annelids of somewhat doubtful relationship to the true Echiuroids" (p. 17).

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## EXPLANATION OF PLATES

All figures were made by the writer directly from dissections or specimens.

### PLATE 20

*Echiurus echiurus alaskanus*, new subspecies

- 1, Dorsal view of anatomy of anterior portion of body,  $\times 5$ . Body wall is indicated only in pharyngeal region. Junction of diaphragm to body wall is indicated by dashes for dorsal half and dots for ventral half. Coiled loops of esophagus are shown emerging from posterior opening of diaphragm, below the interbasal muscle. Lines radiating from pharynx are the muscular frenula. The peripharyngeal coelom is shaded.
  - 2, Anal bristle from posterior ring, 7.5 mm. long.
  - 3, Anal bristle from anterior ring, 8 mm. long.
  - 4, Diagram of the diaphragm (ventral half dotted) showing the posterodorsal opening. The esophagus is omitted except where it pierces the right wall and becomes the gizzard. The edges that are attached to body wall and ventral mesenteries are dashes.
  - 5, Diagram of a section through diaphragm showing how its lower border merges with the ventral mesenteries.
- B*<sup>1</sup>-*B*<sup>4</sup>, dorsal, ring, neurointestinal, and ventral blood vessels, respectively; *C*, stomach; *CG*, ciliated groove; *D*, diaphragm; *G*, gizzard; *MD*, dorsal mesenteries of esophagus; *MV*, ventral mesenteries of esophagus (fig. 5); *N*, nephridium; *NC*, nerve cord; *O*, esophagus, indicated by arrows, ventral mesentery omitted, dorsal mesenteries shown as lighter lines; *P*, pharynx; *S1*, anterior end of siphon; *X*, perivisceral coelom (fig. 4); *X*<sup>1</sup>, peripharyngeal coelom.

### PLATE 21

*Listriolobus pelodes*, new species

- 1, Ventral view of a large specimen from Monterey Bay, Calif.,  $\times 1\frac{1}{2}$ .
- 2, Same specimen,  $\times 5$ , ventral view of anterior end showing nerve loop in proboscis, a section of which has been removed.
- 4, Small phase before muscle bands are evident, natural size.
- 4a, Side view of anterior end of a living specimen,  $\times 3$ .
- 4b, A female,  $\times 3$ , showing nephridia and fecal pellets. At this size the muscle bands are not apparent unless the specimen is strongly contracted. Outline from living animal.

*Ochetostoma octomyotum*, new species

- 3, Ventral view of type specimen from Newport Bay, Calif., natural size. A specimen from Cabrillo Beach, near San Pedro, 95 mm. long, has a proboscis 93 mm.

### PLATE 22

*Listriolobus pelodes*, new species

- Type specimen,  $\times 7$ , dissected to show organs of anterior portion of the body; the alimentary canal is drawn to the right of its natural position.
- B*<sup>1</sup>, dorsal blood vessel; *B*<sup>2</sup>, ring vessel; *B*<sup>3</sup>, neurointestinal connective; *B*<sup>4</sup>, ventral vessel; *C*, stomach; *CG*, ciliated groove of intestine; *G*, gizzard; *I*, intestine;

*MI*, interbasal muscle of setae; *N*, nephridium; *NC*, nerve cord; *O*, esophagus; *P*, pharynx; *P*<sup>1</sup>, posterior end of pharynx; *S*, seta; *Si*<sup>1</sup>, anterior end of siphon; *VM*, ventral mesentery; *X*, parasite.

## PLATE 23

*Ochetostoma octomyotum*, new species

- 1, Dissection,  $\times 2$ ; the spiral funnels of the nephridia and longitudinal muscle bands have been omitted except the midventral, which is lighter shaded.
- 2, Interval between right ventrolateral and lateral muscles at middle of body showing fascicles of the oblique layer. On the lower left corner the oblique layer has been removed,  $\times 20$ .
- 3, Cloaca and adjacent part of intestine opened to show relation with intestinal coecum and anal vesicles,  $\times 5$ .

Lettering as for plate 24.

## PLATE 24

*Ochetostoma octomyotum*, new species

The anterior portion of plate 23, figure 1, enlarged  $\times 5$  and with addition of details.

- A*, anus; *AV*, anal vesicles; *AV*<sup>1</sup>, their opening into cloaca; *B*<sup>1</sup>, dorsal blood vessel; *B*<sup>2</sup>, ring vessel; *B*<sup>3</sup>, neurointestinal connective of which *B*<sup>2</sup> is merely a part; *B*<sup>4</sup>, ventral vessel; *C*, stomach; *CF*, ciliated funnel or nephrostome; *CG*, ciliated groove of intestine; *Cl*, cloaca; *DM*, dorsal mesentery of pharynx; *G*, gizzard; *IC*, intestinal coecum; *IC*<sup>1</sup>, its opening into cloaca; *MC*, outer circular muscle layer; *MD*, dorsal muscle band; *MDL*, dorsolateral muscle band; *ML*, lateral muscle band; *MO*, oblique inner layer of muscles; *MVL*, ventrolateral muscle band; *N*, nephridium; *NC*, nerve cord; *O*, esophagus; *P*, pharynx; *S*, seta; *Si*, siphon; *Si*<sup>1</sup>, entrance to siphon; *Si*<sup>2</sup>, end of siphon; *VM*, ventral mesentery of pharynx.

## PLATE 25

*Arhynchite inamoenus*, new species

- 1, Ventral view of paratype,  $\times 1$ .
  - 2, Seta of type,  $\times 10$ .
  - 3, Dissection of anterior complex of type,  $\times 7$ , showing foregut in situ.
  - 4, Skin of figure 1, from near midventral line, enlarged.
  - 5, Type,  $\times 7$ ; the interbasal muscle has been cut and the liberated foregut drawn to the right; ventral mesentery is dotted.
- B*<sup>1</sup>, *B*<sup>2</sup>, *B*<sup>4</sup>, dorsal, neurointestinal, and ventral blood vessels, respectively; *CF*, nephrostome; *G*, gizzard; *M*, mouth; *MI*, interbasal muscle; *N*, nephridium; *NC*, nerve cord; *O*, esophagus; *P*, pharynx; *S*, seta.

## PLATE 26

*Bonelliopsis alaskana*, new genus and species

- 1, Dissection of specimen from Unalaska, dorsal view,  $\times 4$ .
- 2, Tip of one of the primary branches of an anal vesicle, showing two secondary branches with their ciliated funnels,  $\times 50$ .
- 3, One of the ciliated funnels,  $\times 200$ .
- 4, Nephrostome,  $\times 10$ .

- 5, Anterior end of an individual, the short proboscis apparently in process of regeneration,  $\times 3$ .
  - 6, Ventral view of a worm life size; the second proboscis indicates about the maximum length in preserved specimens.
  - 7, Anterior ventral portion of worm showing the contracted verrucose skin,  $\times 10$ ; when the skin is fully distended the verrucae disappear, the glandular thickenings then appearing as squarish patches, closely spaced.
- Go, gonad; other lettering as for plate 24.

## PLATE 27

*Bonelliopsis alaskana*, new genus and species

- 1, Dissection of anterior end of a specimen with a right nephridium filled with eggs,  $\times 5$ . A "window" has been cut in the dorsal wall of pharynx and also one in the nephridium to show the invaginated tip, within which is the nephrostome. The longitudinal ridges on inner wall of nephridium are indicated by dotted lines.
- 2, Same, anterior end, in contracted state, with right half removed to show relation of dorsal and ventral mesenteries to alimentary canal and ventral mesenteries to alimentary canal and nephridium,  $\times 5$ . Anteriorly only a few of the frenula of pharynx indicated; back of these the transverse mesentery of figure 1 ( $M^1$ ) is indicated as a black line. *DM*, dorsal mesentery, and  $DM^1$  (dot-dash), its attachment to right wall of body (removed); *VM*, ventral mesentery, attached to lower side of intestine and mostly to left side of foregut and involving posterior part of dorsal artery ( $B^1$ ). The nephridium lies in a sort of anterior cul-de-sac or egg trap. When the animal is extended the upper margin of dorsal mesentery is at a distance behind the nephridium, here shown at minimum size.

$M^1$ , a transverse mesentery below the dorsal blood vessel;

$M^2$ , special muscular mesentery between gizzard and stomach, not shown in figure 2; *PV*, position of pyloric valve, mentioned in text; other lettering as for plate 24.

## PLATE 28

*Eubonellia valida*, new genus and species

- 1, Dissection of anterior end of body from above,  $\times 4$ . The foregut has been drawn to the left to show the large nephridium (*N*) with its terminal nephrostome (*CF*). Note the unusually long stomach (*C*), filled with pellets, between the gizzard (*G*) and intestine (*I*). The ventral blood vessel ( $B^1$ ) and the much contracted neurointestinal vessel ( $B^2$ ) have been cross-hatched. The dorsal blood vessel ( $B^1$ ) is unshaded.
- 2, A cluster of nephric elements of an anal vesicle,  $\times 30$ .
- 3, Type, natural size, from below.
- 4, A pellet from the postsiphonal intestine,  $\times 10$ .
- 5, Male, from mouth cavity,  $\times 50$ ; anterior end to right; the sperm receptacle and duct shown.

Lettering as for plate 24.

## PLATE 29

*Nellobia eusoma*, new genus and species

- 1, Ventral view of anterior end of type showing the short truncate snout,  $\times 5$ .
- 2, Ventral view of type,  $\times 1$ .

- 3, Terminal portion of intestine, the cloaca, anus, and anal vesicles,  $\times 5$ .
- 4, Branchlet of anal vesicle,  $\times 50$ .

*NP*, nephridiopore; *Go*, posterior part of gonad with blood vessel and nerve cord underneath; *M*, mesenteries; other lettering as for plate 24.

#### PLATE 30

##### *Nellobia eusoma*, new genus and species

- 1, Dissection of anterior portion of type, seen from above,  $\times 5$ . The nephridium, filled with eggs (0.85 mm. in diameter) on the left, has a window cut in the wall to show the constricted duct from the egg chamber. The swollen duct leading to external opening lies under the nerve cord and ventral blood vessel.
  - 2, Pharynx,  $\times 5$ . Interior; anterior end looking toward mouth. The dorsal side has been cut open.
- B<sup>1</sup>*, *B<sup>2</sup>*, *B<sup>3</sup>*, dorsal, neurointestinal, and ventral blood vessels, respectively; *CF*, nephrostome; *D*, peripheral portion of peripharyngeal diaphragm (the central portion adjacent to pharynx has been removed); *DM*, dorsal mesenteries; *G*, gizzard; *Go*, gonad; *M*, mesenterial sheet holding loop of pharynx-esophagus; *NC*, nerve cord; *O*, esophagus; *Si1*, beginning of siphon; *VM*, ventral mesentery of pharynx-esophagus; *X-Y*, probable extent of gizzard; at *Y* the canal was broken, and it is possible that a portion of the succeeding stomach was lost.

#### PLATE 31

##### *Acanthohamingia paradola*, new species

- 1, Ventral aspect of paratype,  $\times 1$ .
  - 2, Same specimen; genital groove, extending forward from nephridiopore (*N*) and showing four males in situ,  $\times 5$  ( $\hat{\sigma}$ , males attached to skin).
  - 2a, Anterior portion of figure 2,  $\times 15$ .
  - 3, Type; genital groove in probably the normal closed state,  $\times 5$ .
  - 4, Genital groove of third specimen that has two nephridiopores (*N*),  $\times 5$ .
  - 4a, Nephridiopores of above, enlarged.
  - 5, Male from genital groove of paratype (fig. 2), 1.19 mm. long,  $\times 50$ .
  - 6, Type; anal vesicles and thin-walled cloaca from above,  $\times 3$ . The anus can be seen through the thin wall of the cloaca, and on the left most of the tubes spring from a rudimentary bladder.
- I*, intestine (missing from type); *M*, mouth; *N*, nephridiopore; *S*, spermatheca (nephridium).

#### PLATE 32

##### *Acanthohamingia paradola*, new species

- Dissection of anterior part of animal from above,  $\times 4$ . Note the very long foregut ending at *B<sup>1</sup>* and the long (as compared with *Bonellia*) segment of intestine between *B<sup>1</sup>* and *Si1*.
- B<sup>1</sup>*, *B<sup>2</sup>*, *B<sup>3</sup>*, dorsal, neurointestinal, and ventral blood vessels, respectively; *C*, portion corresponding to stomach of other bonelliids; *CF*, nephrostome; *G*, probable gizzard; *I*, intestine; *N*, nephridia; *NC*, nerve cord; *O*, esophagus; *P*, pharynx, *Pe*, pellet,  $\times 10$ ; *Si*, siphon; *Si1*, anterior end of siphon.



## PLATE 33

*Urechis caupo* Fisher and MacGinitie

- 1, Dissection of contracted specimen from above, showing the intestine in haphazard convolutions. The principal mesenterial bands, which anchor the intestines to the body wall, are shown but not lettered. The coelomic apertures of the nephridia are recognizable by the conspicuous coiled lips. The arrow indicates point where pharynx becomes esophagus. The figures in sequence on the midgut are intended to aid in following the convolutions; 1 is at the beginning and 13 near the end. Beyond 13 the slight diverticulum of the respiratory gut is indicated.
- 2, Pharynx contracted and slit open along ventral side to show the straight longitudinal folds of lining, continuous with those of the proboscis. Posteriorly is shown characteristic lining of esophagus; on each side are the dorsal mesenteries. In front of these the ventral mesenteries are spread laterally since pharynx has been opened ventrally (see pl. 34, fig. 2, 14).
- 3, Ventral surface of proboscis and anterior end of body.
- 4, Posterior end of body showing eccentric anus and circle of setae; + marks the midventral line.
- 5, Two views of the anterior setae. The line indicates 1 mm.
- 6, An anal seta, same scale as figure 5, with, below, a tip enlarged.

AS, anterior setae (accessory seta shown at side; muscles not drawn); AV, anal vesicles; C<sub>1</sub>, C<sub>2</sub>, crops 1 and 2 of Seitz, subtended by muscular bands M<sub>1</sub> and M<sub>2</sub>; C<sub>3</sub> is the stomach; CL, cloaca, the posterior portion lined with heavy longitudinal ridges (arrows mark apertures of anal vesicles); G, gizzard, a portion of the foregut lying between C<sub>1</sub> and C<sub>2</sub>, characterized by thick muscular walls and circular muscular ridges and constrictions; HG, respiratory gut, specialized posterior segment of midgut; M<sub>1</sub>, M<sub>2</sub>, muscular bands of crop and stomach (C<sub>3</sub>); N, nephridium; NC, nerve cord; O, esophagus, anterior limit marked by an arrow; P, pharynx; PS, posterior or anal setae; S, siphon or accessory intestine; S1, beginning of siphon near beginning of midgut; S2, end of siphon; VM, ventral mesenteries of pharynx; 1-13, these figures are in sequence along the midgut and are intended to aid in following the course; 13 is near the junction of midgut and its terminal specialized portion, the respiratory gut.

## PLATE 34

*Urechis caupo* Fisher and MacGinitie

- 1, Dissection of contracted individual showing the generically characteristic parts of alimentary canal, most of the "small intestine" having been removed. The very long foregut consists of pharynx (anterior to P), esophagus (O), crop (C<sub>1</sub>) with its strong muscular mesentery, gizzard (G), and stomach (C<sub>2</sub>) anchored posteriorly by a strong mesentery here shown in maximum contraction. S1 is beginning of siphon (pl. 35, fig. 5). Attachment of respiratory gut is always on left of nerve cord (NC). Along its dorsal surface is shown the muscle strand continued from the small intestines and serving posteriorly for attachment of a few dorsolateral mesenteries.
- 2, Head region of coelom looking forward from just behind first pair of nephridia (16) showing arrangement of muscular mesenteries of pharynx: 1-7, dorsal and dorsolateral; 8-12, lateral and ventrolateral; 13, the dorsoventral muscles mentioned in text; 14, ventral mesenteries of pharynx; 17, nerve

cord; crossing the ventral mesenteries between the two figure 14's is the interbasal muscle of setae; radiating muscles of setae shown in solid black on right.

- 3, Anterior aspect of a nephridium of second pair showing nephrostome and elongated lips spirally coiled,  $\times 5$ .
- 4, A nephridium from a specimen 40 mm. long, not yet sexually mature,  $\times 20$ .

#### PLATE 35

##### *Urechis caupo* Fisher and MacGinitie

- 1, Arrangement of intestine and mesenteries in fully expanded specimen,  $\times \frac{1}{4}$ . Anterior and posterior portions of body have been omitted and the intestine has been spread to right and left to show attachments. Normally these lateralmost parts overlie the darker and more mesially located portions. A section has been removed from respiratory gut to show attachment of mesenteries. *C*<sup>1</sup>, crop; *C*<sup>2</sup>, stomach; *G*, gizzard; *HG*, respiratory gut; *M*<sup>2</sup>, mesentery of stomach; *NC*, nerve cord; *Si*, siphon; *Si1* and *Si2*, anterior and posterior end of siphon.
- 2, Portion of midgut at *X* of figure 1, showing its highly sacculate structure; mucosa with fine anastomosing plications, transverse in direction; *Si*, siphon,  $\times 2$ .
- 3, Postsiphonal midgut at *XX* of figure 1,  $\times 2$ , showing the mucosa and longitudinal muscle band marking position of ciliated groove.
- 4, 4a, Cestode larvae from anterior end of the siphon,  $\times 60$ . These larvae vary in length from 0.25 to 0.32 mm. and are free in the lumen of siphon and in the hernialike swellings, which may be caused by them (see fig. 5, above *Si1*).
- 5, Sagittal section,  $\times 5$ , of the distal end of stomach and beginning of midgut and siphon, showing macroscopic character of mucosa; *C*<sup>2</sup>, stomach; *CG*, one side only the ciliated groove; the groove is constituted by two of these finely plicated folds or ridges of the mucosa. The plications are coarser and the groove is broader in the short segment *CG*<sup>1</sup>; *Si*, siphon, showing foliose mucosa. The cestode larvae were found in this portion and in the hernialike swellings shown just above *Si1*, the narrow passage connecting midgut and siphon.
- 6, Fecal pellets,  $\times 3$ . Specimen from Monterey Bay, Calif.

#### PLATE 36

- 1, *Urechis chilensis* (Müller): Anterior end of respiratory gut showing mode of attachment by muscular mesenteries,  $\times 3$ . Compare with figures 2 and 3.
- 2, *Urechis caupo* Fisher and MacGinitie,  $\times 1.5$ .
- 3, *Urechis unicinctus* (von Drasche),  $\times 5$ .
- 4, *Urechis caupo*: Cloacal region of a relaxed specimen (pl. 35, fig. 1) with the posterior part of respiratory gut; dorsal wall of cloaca removed. *AV*, anal vesicle; *M*<sup>2</sup>, muscular mesentery anchoring the stomach; *M*<sup>1</sup>, muscular frenula of cloaca; *N*, nephridia; *NC*, nerve cord; *PS*, posterior setae.

#### PLATE 37

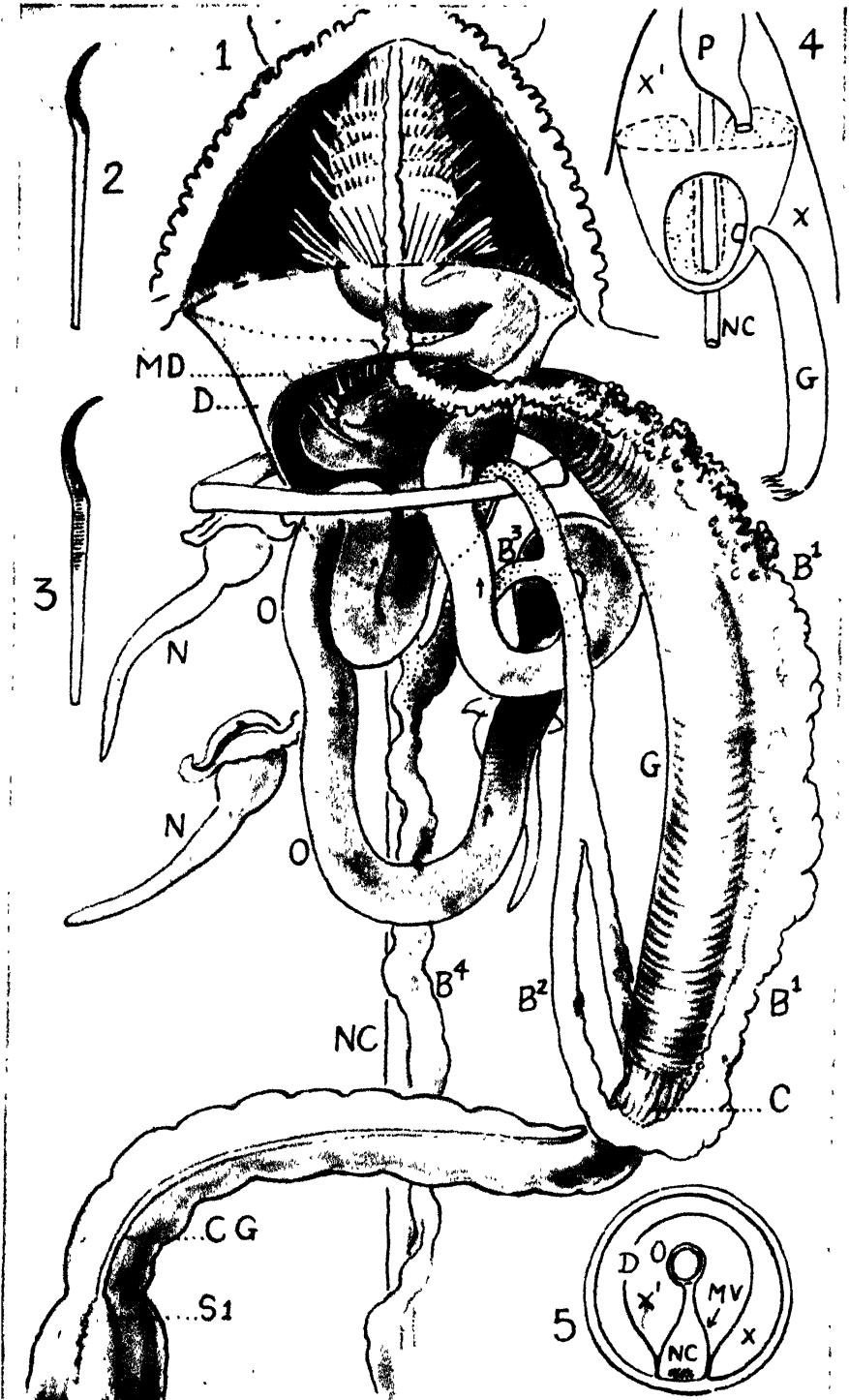
##### *Urechis caupo* and Commensals

- 1, Portion of tunnel showing one position of worm while pumping water through its slime-net and characteristic stations of commensals,  $\times \frac{1}{4}$ . *A*, *Clellandia ios* (Jordan and Gilbert) at mouth of tube; *B*, *Hesperonoe advenior* (Skogsberg); *C*, *Scleroplax granulata* Rathbun; *D*, *Cryptomya californica* (Conrad). At upper point where tube is interrupted one inch has been omitted, at lower point four inches.

- 2, *Scleroplax granulata* Rathbun, male,  $\times 3$ .
- 3, *Hesperonoë adventor* (Skogsberg), type  $\times 1$ .
- 4, Specimen of *U. caupo* with slime-tube in place, with the thickening at point of attachment to body indicated. The worm is shown in characteristic pumping posture;  $\times 3$ .
- 5, Characteristic posture while tube is being secreted; tube just begun; entrance indicated by dots;  $\times 1\frac{1}{2}$ .
- 6, Expression of worm while swallowing slime-tube.
- 7, Grasping slime-tube at moment of starting to swallow. The proboscis is holding the posterior edge of tube while a portion is being sucked in on ventral side. This step occupies about three seconds.

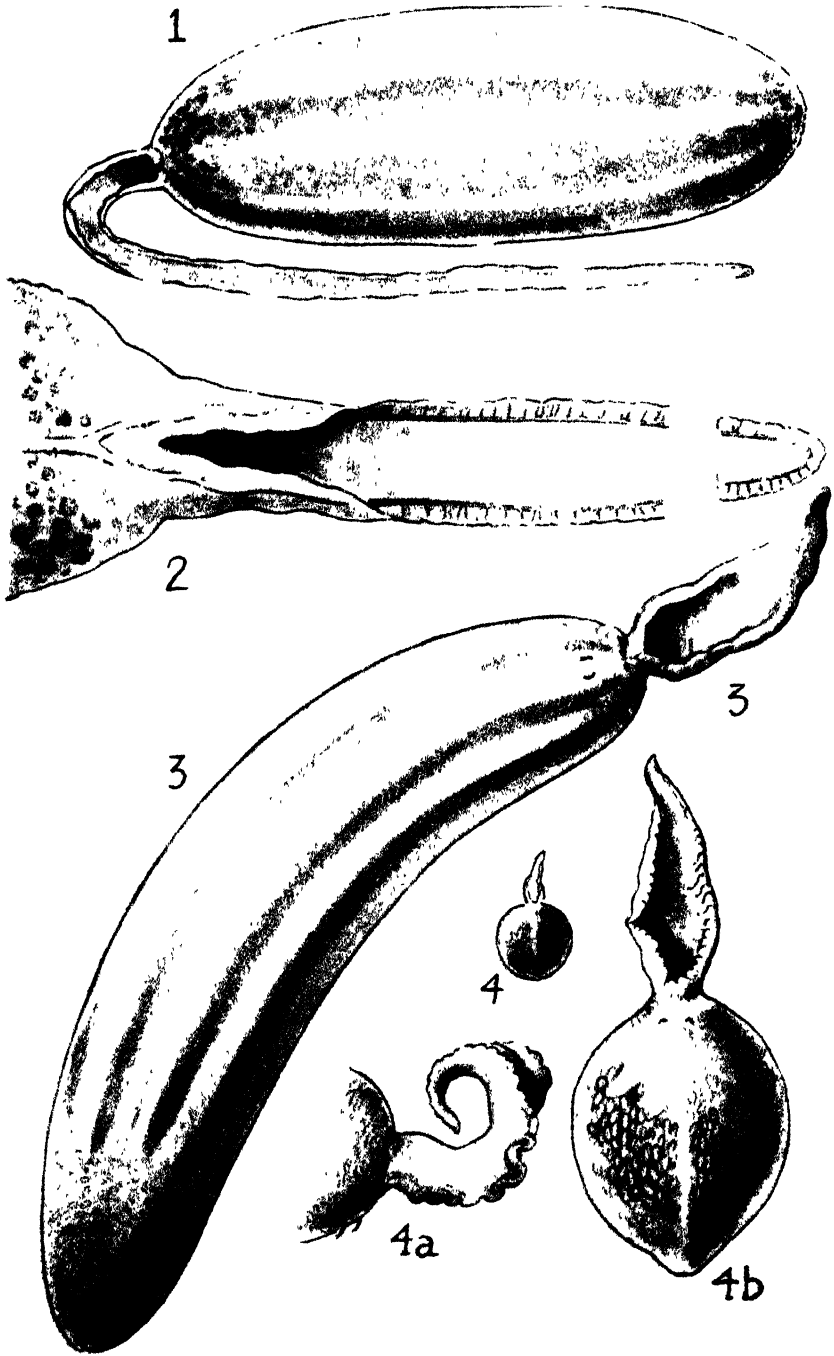






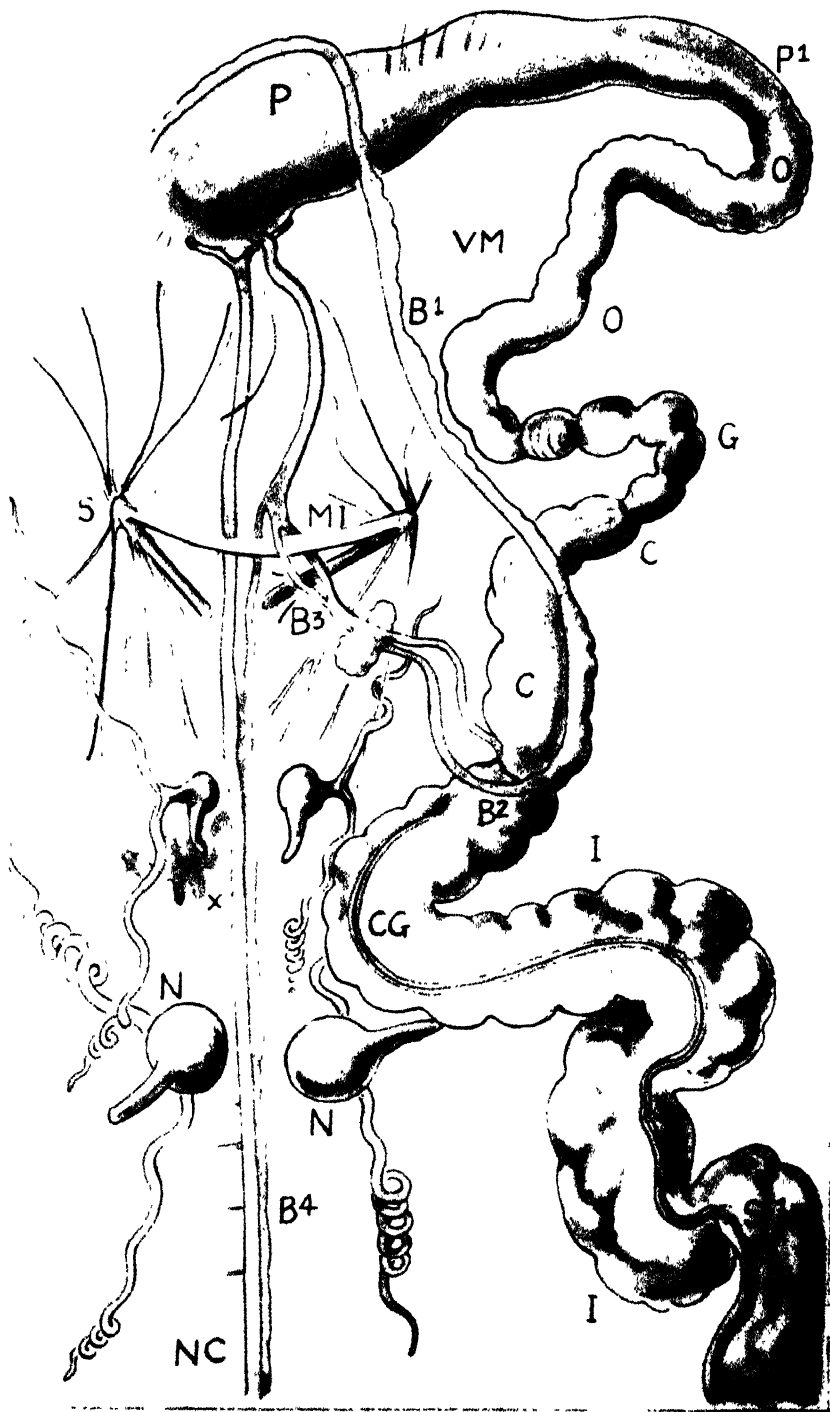
ECHIURUS ECHIURUS ALASKANUS NEW SUBSPECIES

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*LISTRIOLOBUS PELODES* NEW SPECIES, AND *OCHETOSTOMA OCTOMYOTUM*, NEW SPECIES

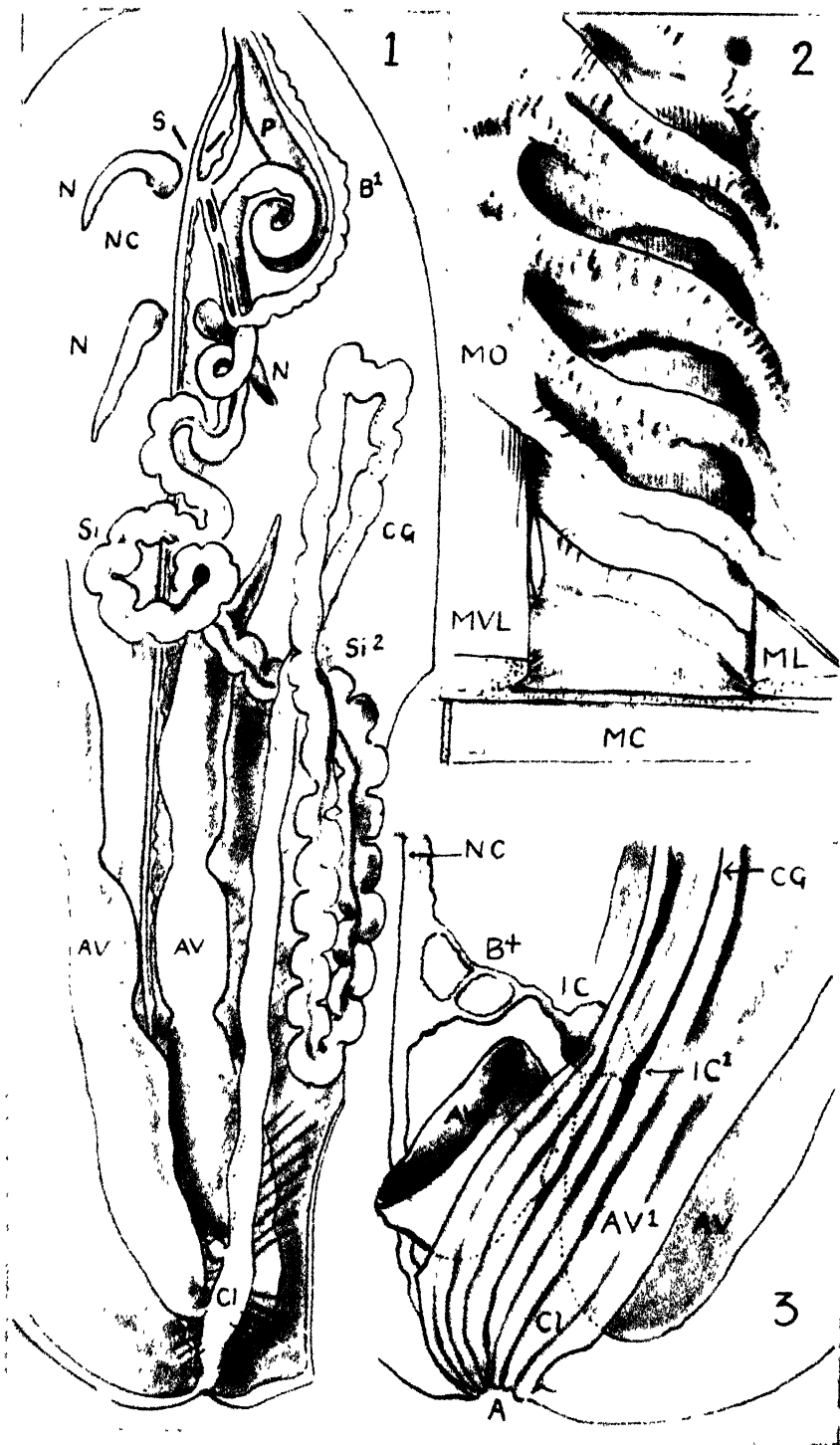
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*LISTRIOLOBUS PELODES*, NEW SPECIES

FOR EXPLANATION SEE PAGES 286, 287

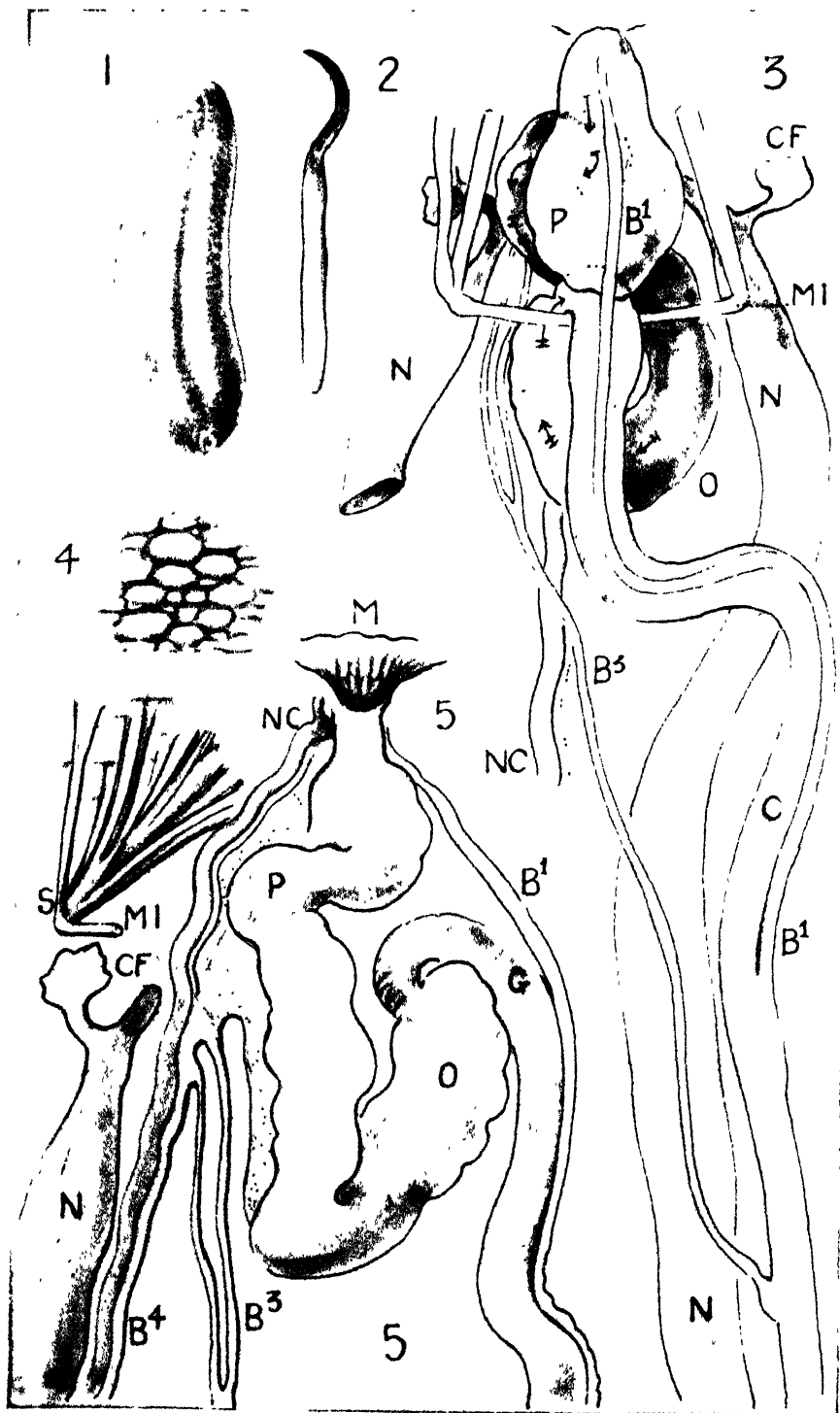




OCHETOSTOMA OCTOMYOTUM, NEW SPECIES  
FOR EXPLANATION SEE PAGE 97

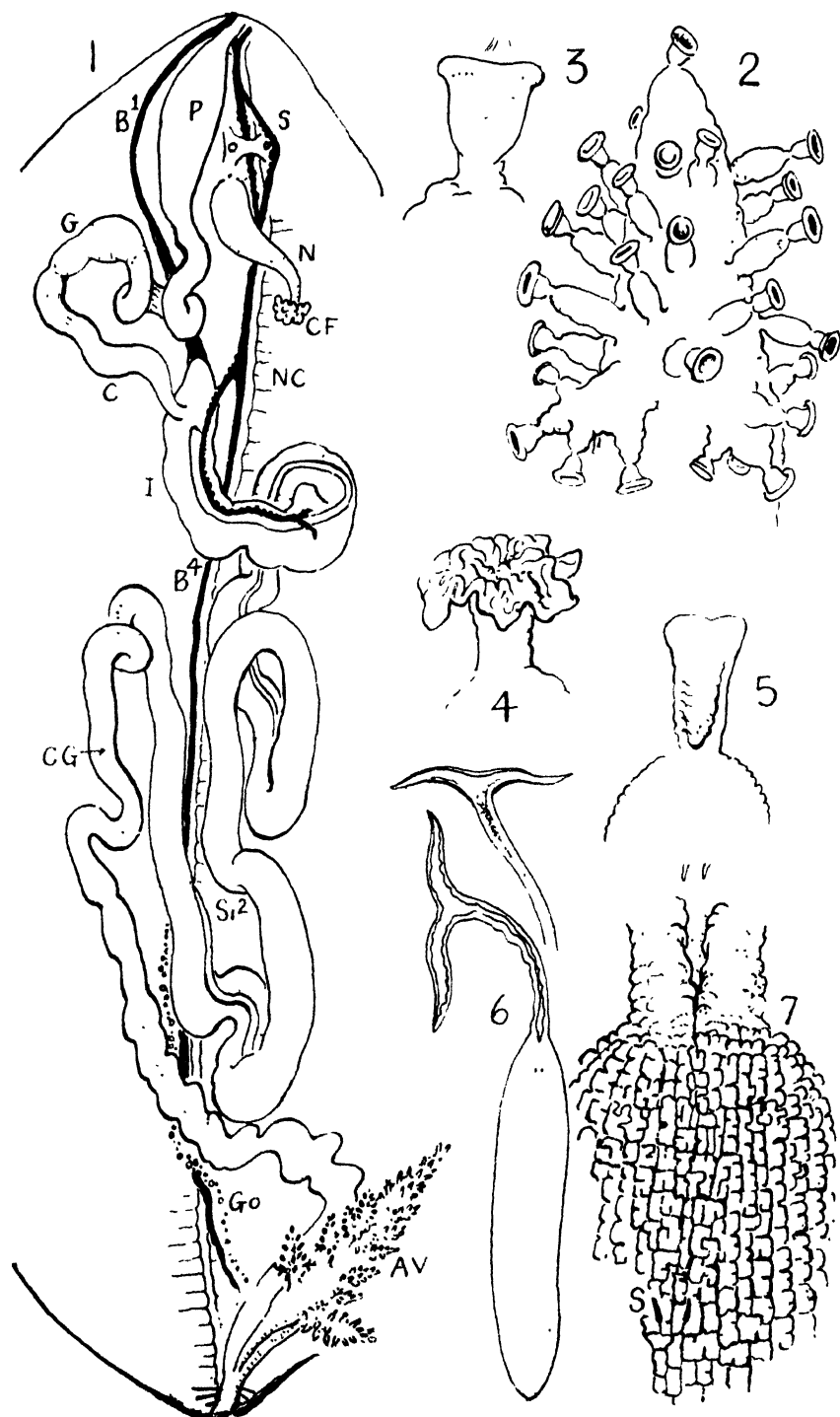


OCHETOSTOMA OCTOMYOTUM NEW SPECIES  
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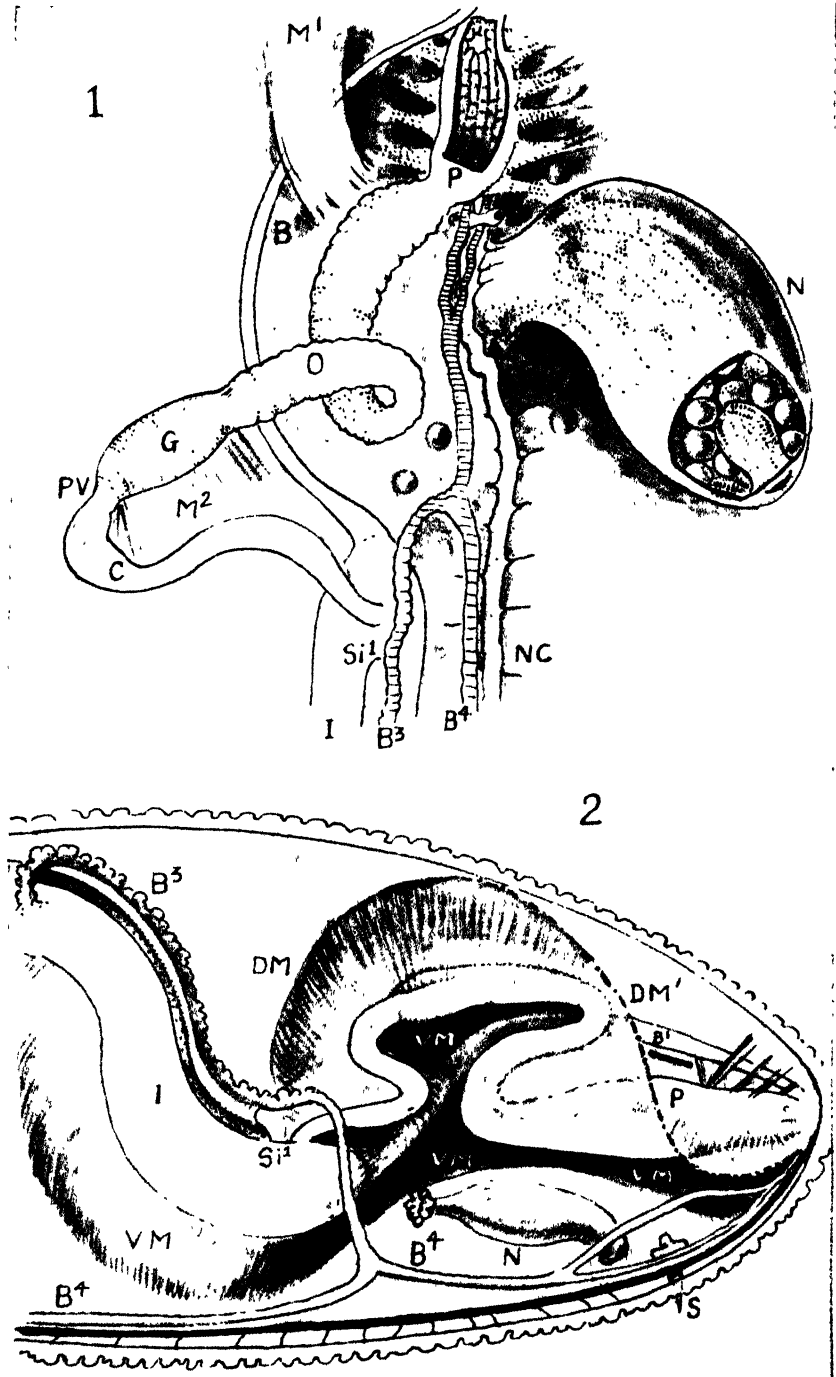
ARHYNCHITE INAMOENUS, NEW SPECIES

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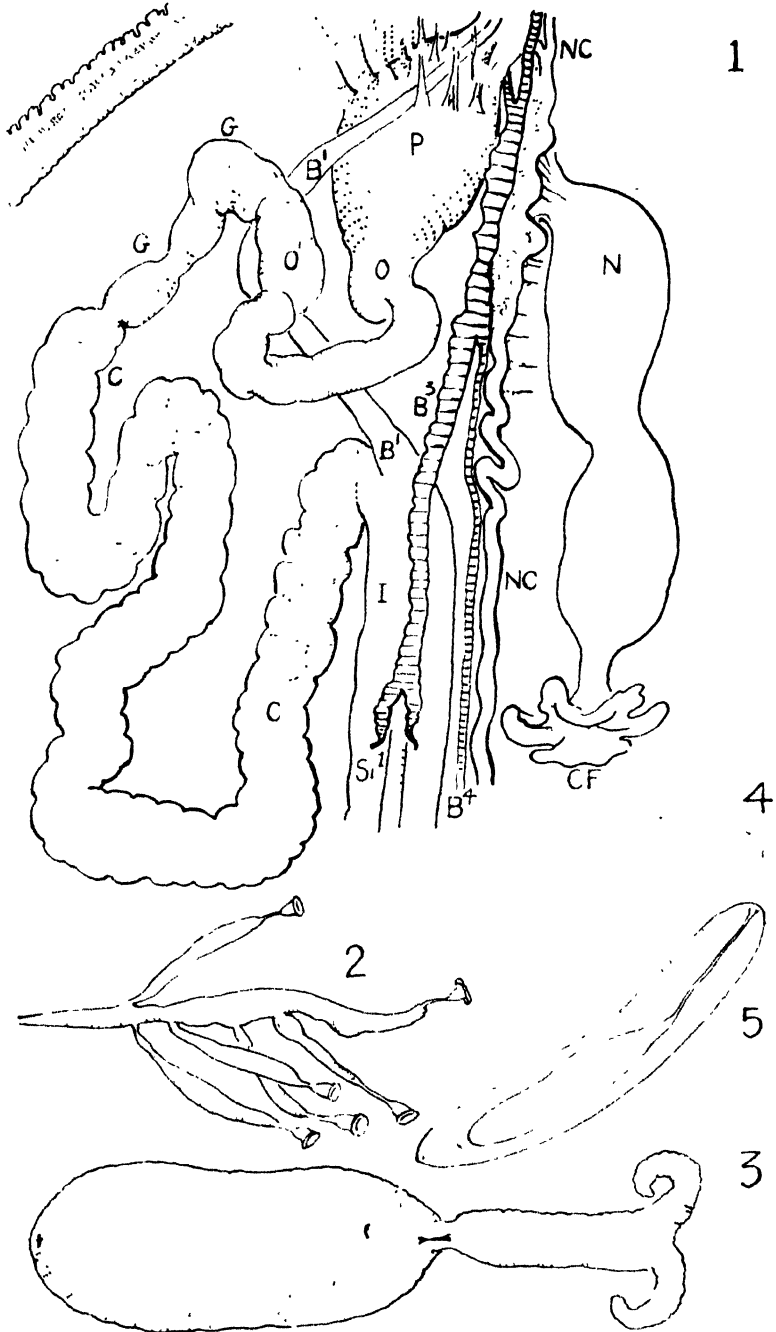


BONELLIOPSIS ALASKANA, NEW GENUS AND SPECIES

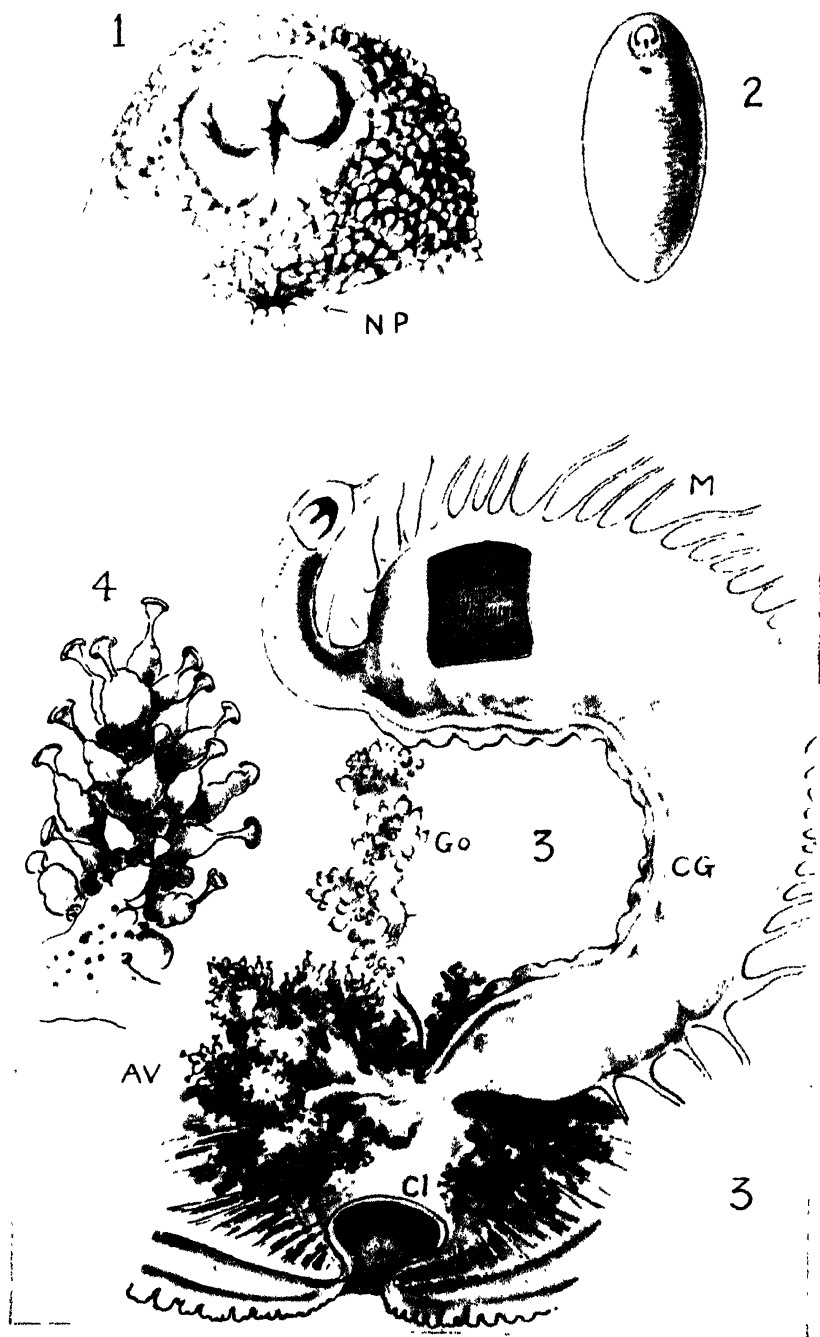
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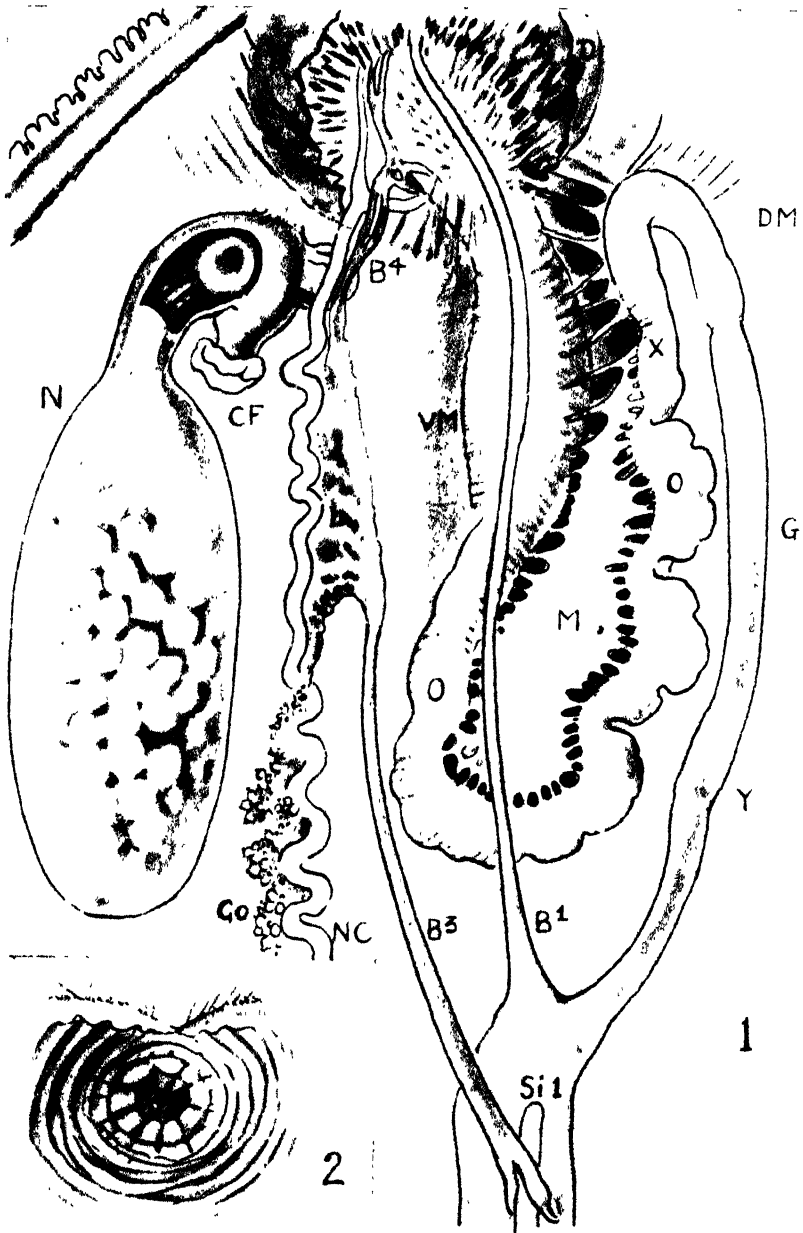
BONELLIOPSIS ALASKANA, NEW GENUS AND SPECIES  
FOR EXPLANATION SEE PAGE 288



EUBONELLIA VALIDA NEW GENUS AND SPECIES  
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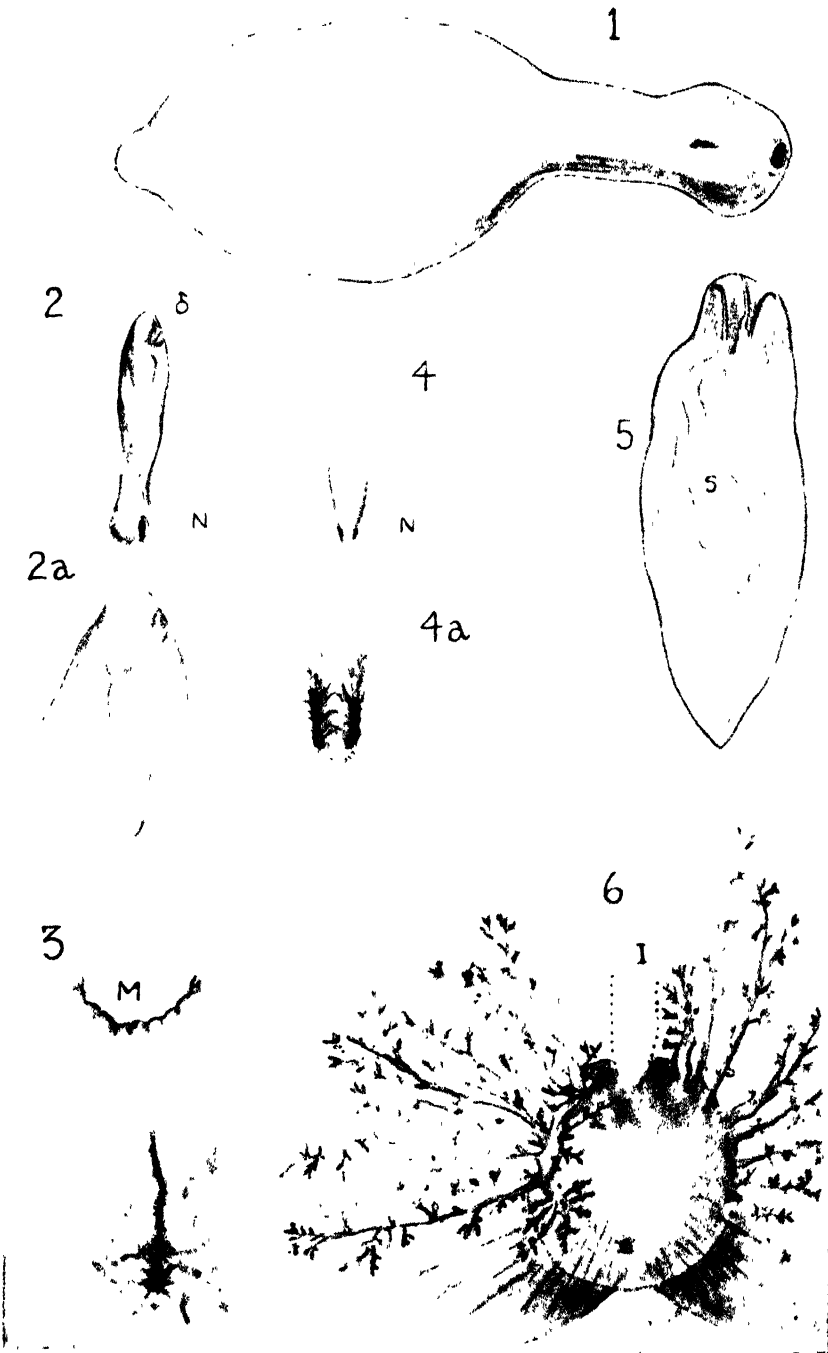


NELLOBIA EUSOMA, NEW GENUS AND SPECIES  
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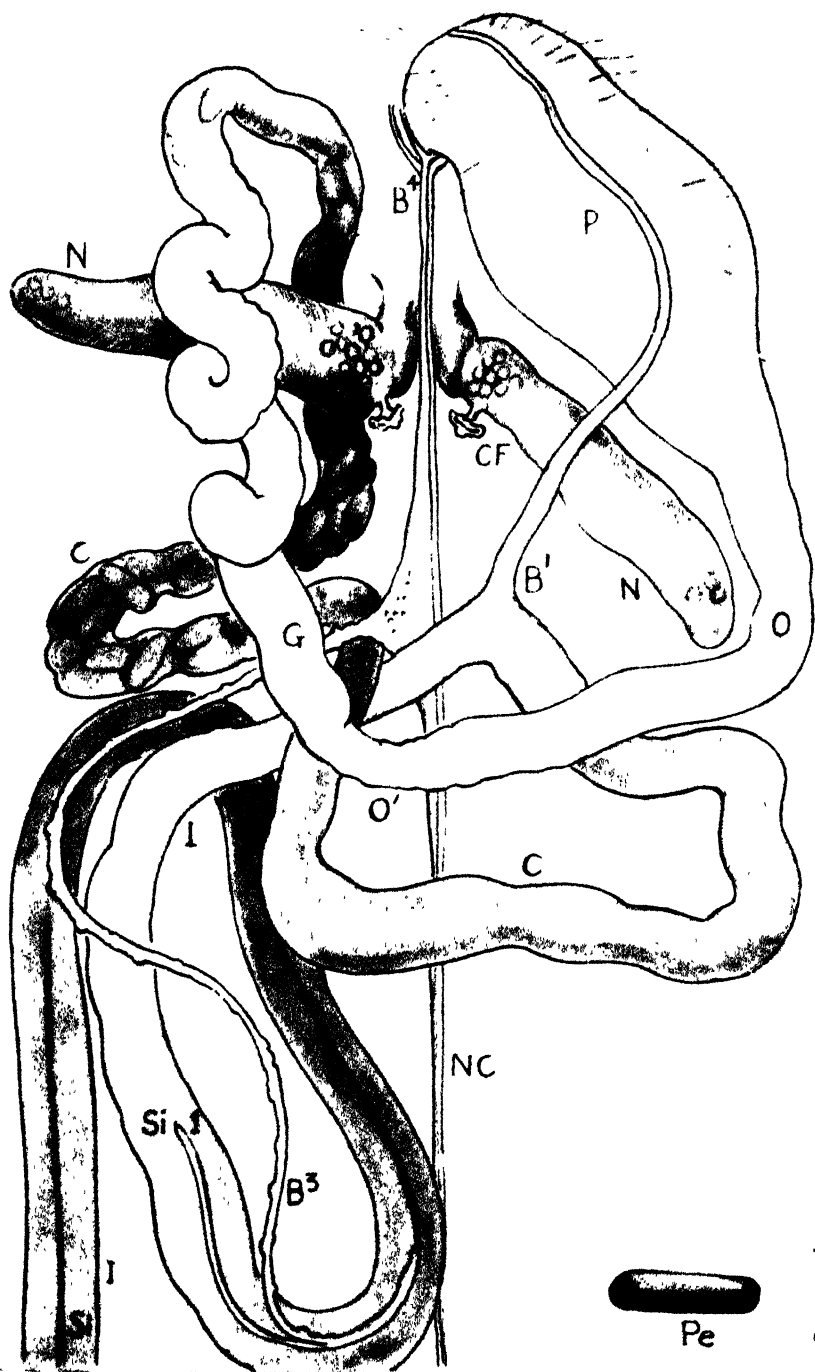


NELLOBIA EUSOMA NEW GENUS AND SPECIES  
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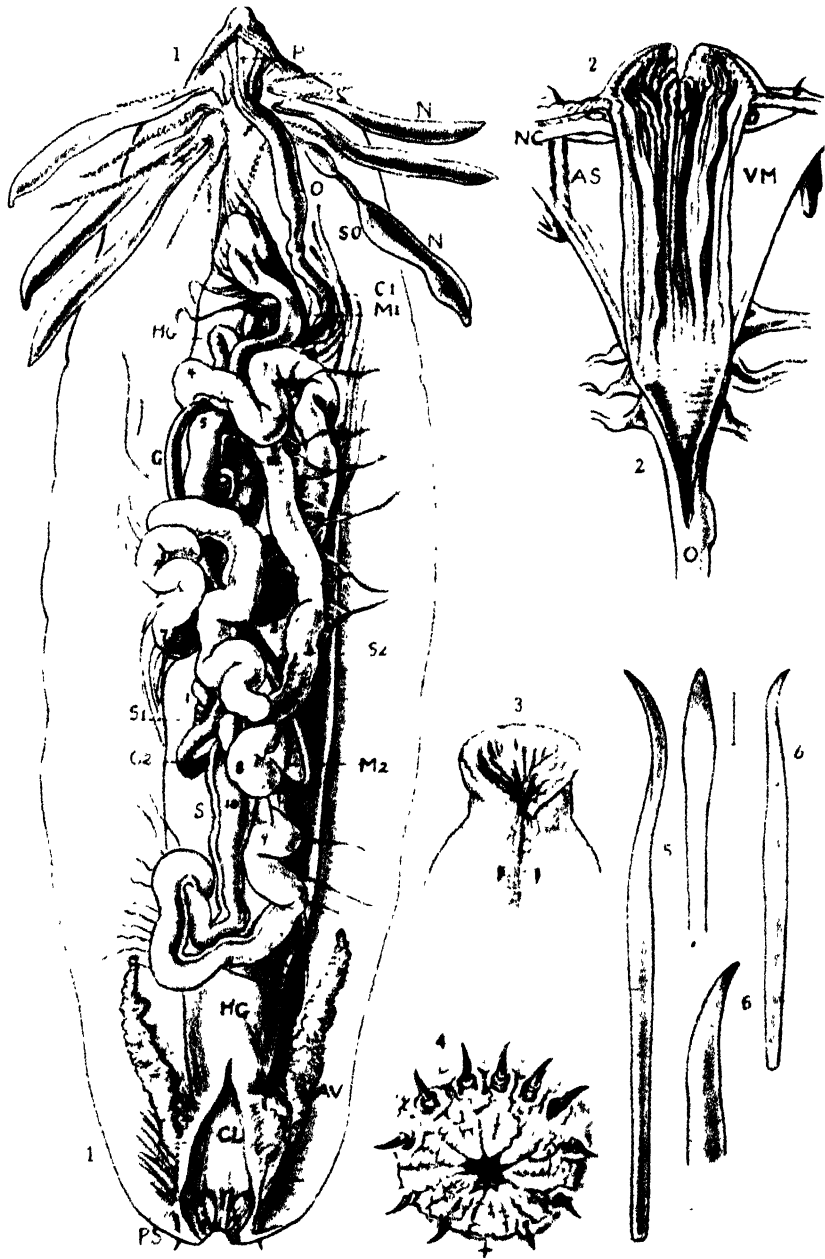




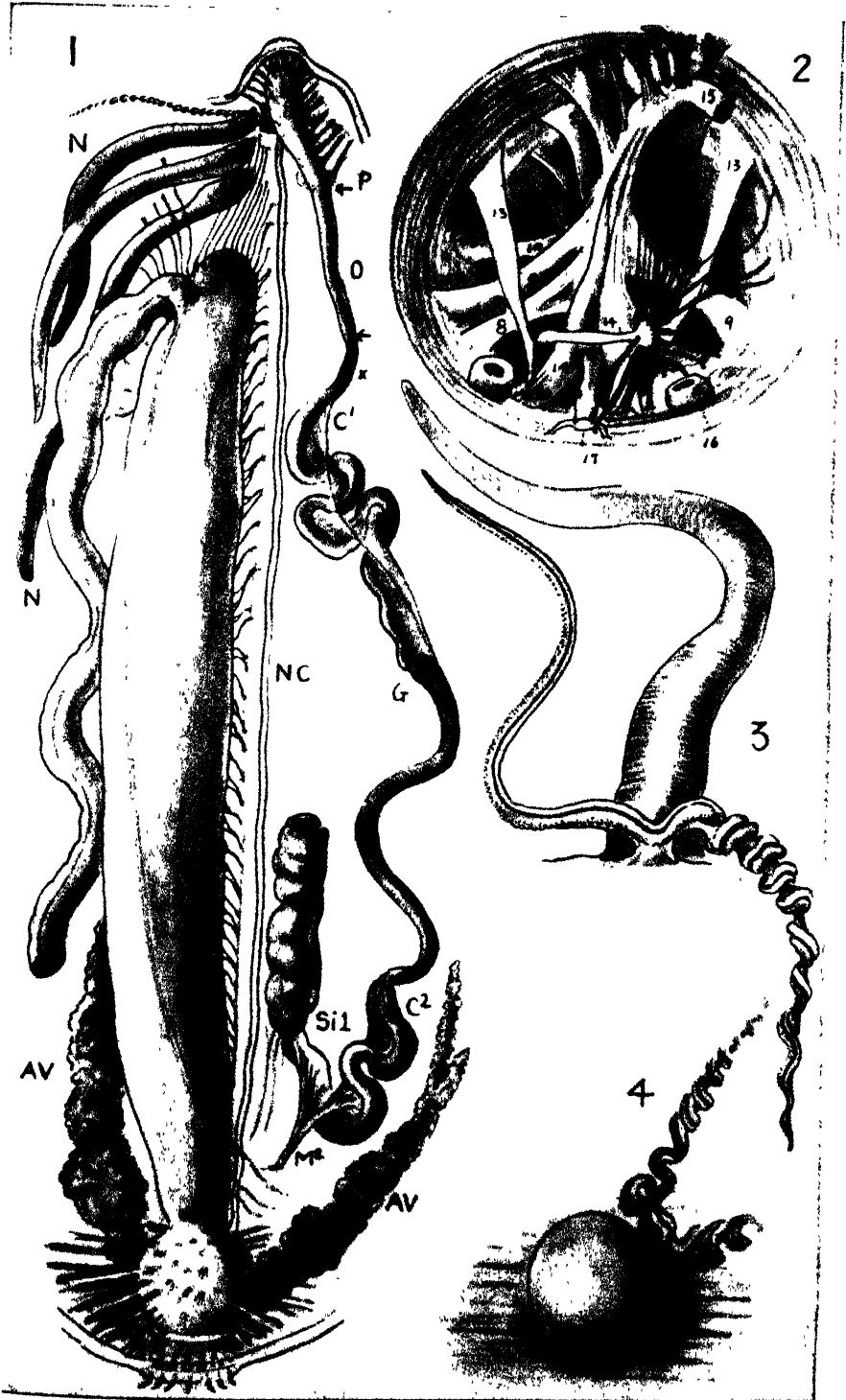
ACANTHOHAMINGIA PARADOLA. NEW SPECIES  
FOR EXPLANATION SEE PAGE 289



ACANTHOHAMINIGIA PARADOLA NEW SPECIES  
FOR EXPLANATION SEE PAGE 229

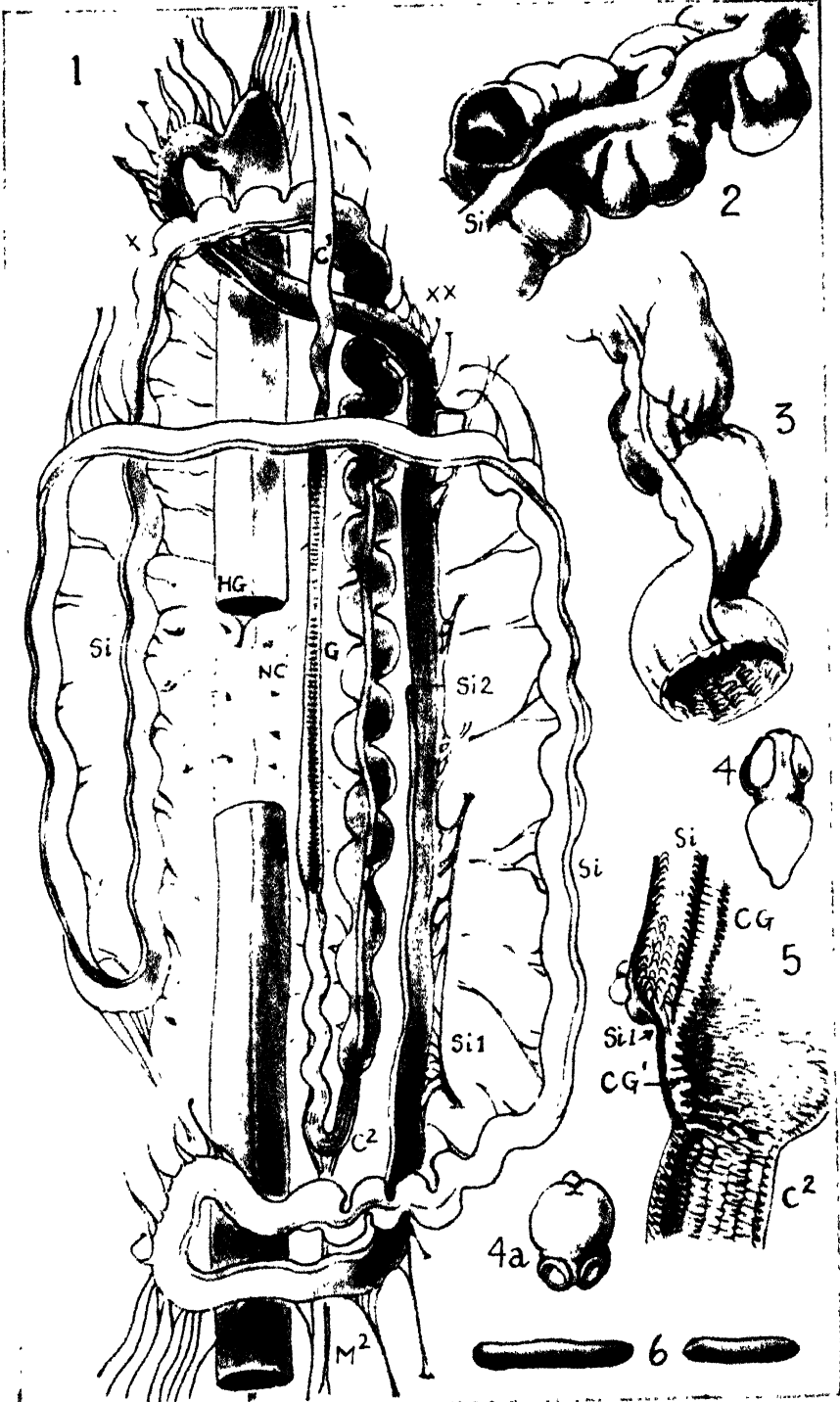


URECHIS CAUPO FISHER AND MACGINITIE  
FOR EXPLANATION SEE PAGE 290

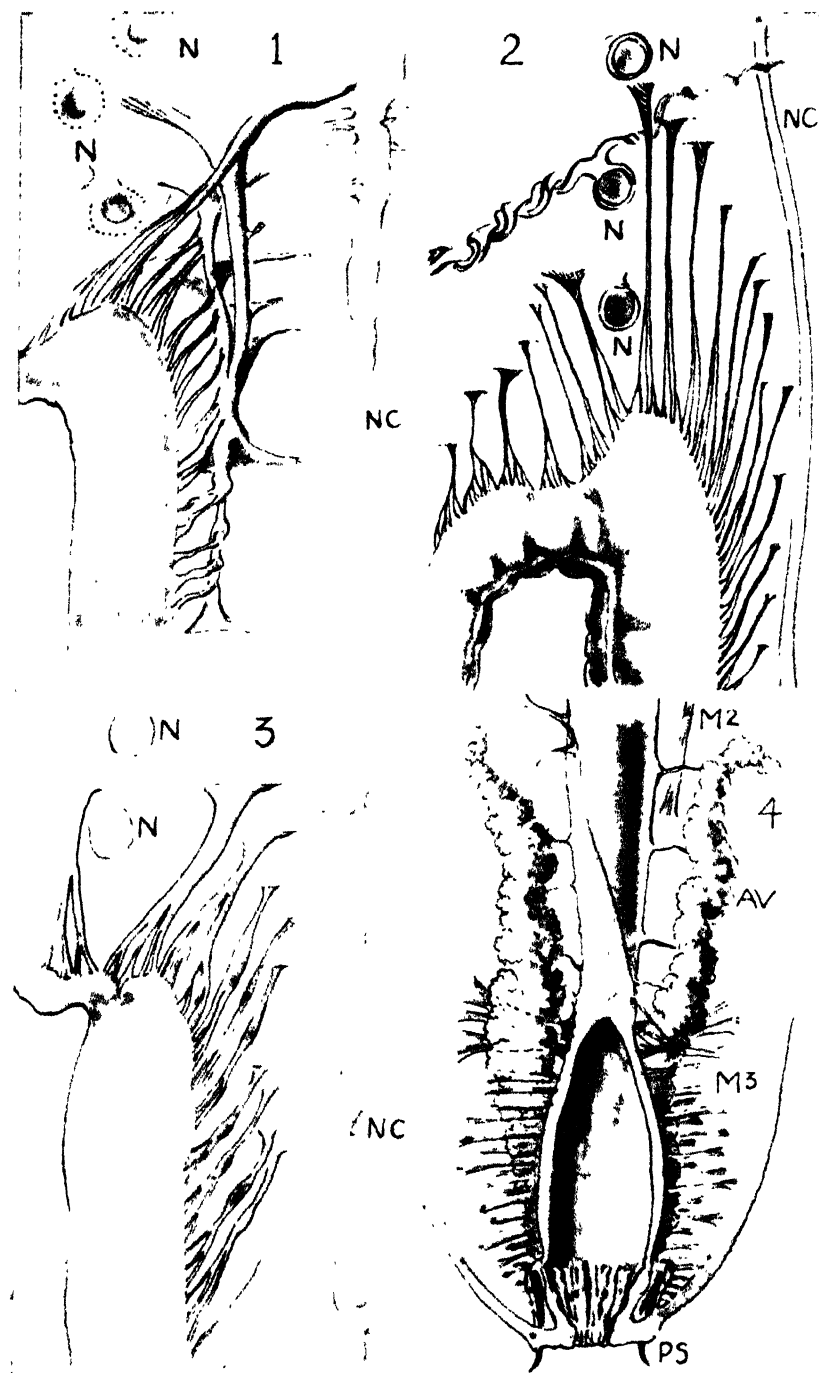


URECHIS CAUPO FISHER AND MACGINITIE

FOR EXPLANATION SEE PAGES 290-291



URECHIS CAUPO FISHER AND MACGINITIE  
FOR EXPLANATION SEE PAGE 291



URECHIS CAUPO, U. CHILENSIS, AND U. UNCINATUS  
FOR EXPLANATION SEE PAGE 29



URECHIS CAUPO AND COMMENSALS  
FOR EXPLANATION SEE PAGES 291-292









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THE OSTEOLOGY OF THE FOSSIL TURTLE *TESTUDO*  
*PRAEEXTANS* LAMBE, WITH NOTES ON OTHER  
SPECIES OF *TESTUDO* FROM THE OLIGOCENE OF  
WYOMING

By CHARLES W. GILMORE

Among the fossil vertebrate materials collected from the Oligocene of the Indian Creek Basin area in Wyoming by the Smithsonian Paleontological Expeditions of 1932 and 1942 were six well-preserved specimens of the land tortoise *Testudo*. Interest in these specimens centers primarily in the fact that they contribute the first information to be had of the skull and internal skeleton of *Testudo praeextans* Lambe, as well as illustrating the individual variation found in the shell structure of that species. Two of these specimens pertain to *Testudo laticuneus* Cope, this being the first time this species has been recognized in this area.

Family TESTUDINIDAE

Genus *TESTUDO* Linnaeus

*TESTUDO PRAEEXTANS* Lambe

PLATES 38-41; PLATE 44, FIGURE 2

*Testudo praeextans* LAMBE, Ottawa Nat., vol. 27, pp. 57-61, pls. 4, 5, 1913.—HAY, Carnegie Inst. Washington Publ. 390, p. 104, 1930.

*Diagnosis*.—The characters that at this time appear to distinguish *Testudo praeextans* are as follows: Carapace depressed, with flattened top in the vertebral region; prominent epiplastral lip, projecting beyond the borders of the carapace and with parallel sides; sulci usually shallowly impressed and usually ending, on free borders, in

\*Mr. Gilmore died on September 27, 1945.—ED.

a projecting point or mucro; neurals variable but usually less differentiated than in most species of the genus; first neural longest of the series; entoplastron pointed in front, rounded behind; gular scutes constantly encroaching on the entoplastron; suprapygal usually in contact with the eleventh peripheral only, rarely reaching the pygal; median longitudinal ridge in front of the choanae.

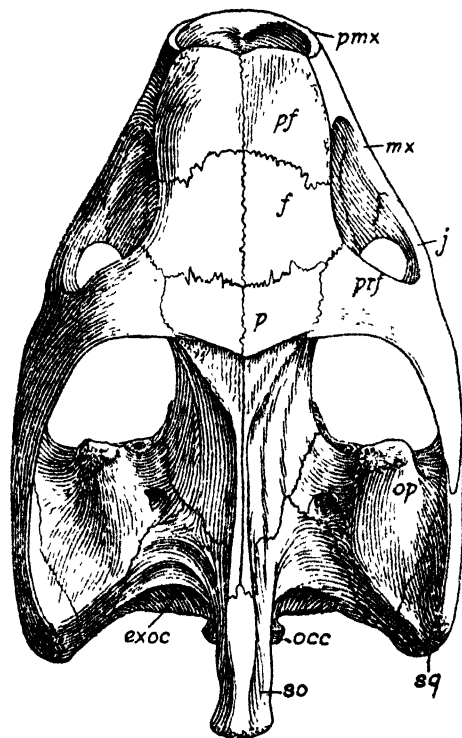


FIGURE 20.—Skull of *Testudo praeextans* Lambe (U.S.N.M. No. 15874), superior view: *exoc*, exoccipital; *f*, frontal; *j*, jugal; *mx*, maxillary; *occ*, occipital condyle; *op*, opisthotic; *p*, parietal; *pf*, prefrontal; *pmx*, premaxillary; *ptf*, postfrontal; *so*, supraoccipital; *sq*, squamosal. Natural size.

*Materials*.—The four specimens pertaining to *Testudo praeextans* are all from Niobrara County, Wyo., and from the Brule division of the Oligocene. The best-preserved specimen, U.S.N.M. No. 15874, collected in 1932, consists of the complete carapace, plastron, skull, lower jaws, pectoral and pelvic girdles, both humeri, both ulnae, one radius, both femora, both tibiae, one fibula, and parts of all four feet. It was found on the Anderson Ranch on the south side of Young Woman Creek; specimen U.S.N.M. No. 15878, collected in 1932, was found on the east side of Little Indian Creek and consists of the complete shell, parts of both humeri, both ulnae, both radii, one articulated forefoot, and portions of the other three forefeet; specimen U.S.N.M.

No. 16728 was found in 1942 about a mile north of Whitman Post-office and consists of carapace, plastron, humerus, both scapulae, both coracoids, both tibiae, both fibulae, tarsals, and some foot bones; specimen U.S.N.M. No. 16732 was collected in 1942 on the Anderson Ranch on the north side of Young Woman Creek and consists of carapace, plastron, pelvis, two humeri, coracoid, two scapulae, tibia, two ulnae, two radii, parts of both fibulae, and foot bones.

#### DESCRIPTION

*Skull*.—Of the 48 or more species of *Testudo* described from North America, the skulls of only six are known at the present time. These are *Testudo thomsoni* Hay, *T. peragrans* Hay, *T. osborniana* Hay, *T. impensa* Hay, *T. orthopygia* (Cope), and *T. gilberti* Hay; and only one of these, *T. thomsoni*, is from the Oligocene. To this list we may now add *T. praeextans* Lambe, represented by an unusually well preserved skull and lower jaws belonging to specimen U.S.N.M. No. 15874 and illustrated in three views in figures 20–22.

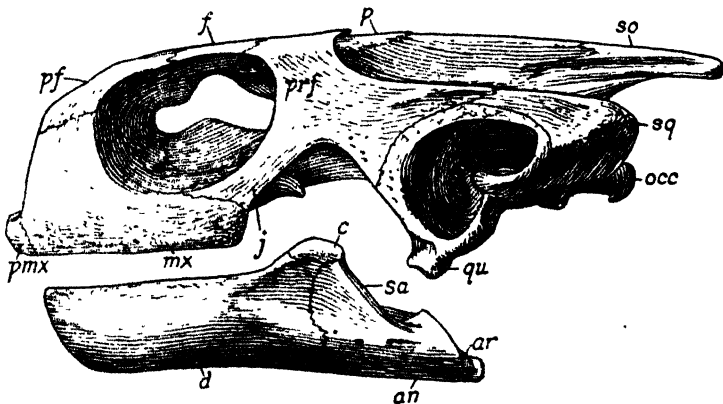


FIGURE 21.—Lateral view of skull and lower jaws of *Testudo praeextans* Lambe (U.S.N.M. No. 15874): *an*, angular; *ar*, articular; *c*, coracoid; *d*, dentary; *f*, frontal; *j*, jugal; *mx*, maxilla; *occ*, occipital condyle; *p*, parietal; *pf*, prefrontal; *pmx*, premaxillary; *prf*, postfrontal; *qu*, quadrate; *sa*, surangular; *so*, supraoccipital; *sq*, squamosal. Natural size.

The skull and lower jaws of this specimen are practically complete and undistorted, with many of the cranial sutures clearly distinguishable (fig. 21). The skull is of moderate size. Its length, from the tip of the premaxillary to the occipital condyle, is 81 mm.; its width across the squamosals is 57 mm.; the height from the cutting edge of the maxilla to the upper surface of the frontal is 26 mm. The sides of the skull forward to the backs of the orbits are nearly parallel; beyond here they regularly converge to the broadly rounded snout. Viewed from the side the upper outline of the skull is nearly straight to a point above the anterior borders of the orbits where the prefrontals bend strongly downward.

The prefrontals meet along the median line, a distance of 16 mm., and this is also the length of the suture between the frontals. The lateral angles of the skull extend backward to a point slightly posterior to the occipital condyle. The orbit has a greatest anteroposterior diameter of 23 mm.; the nasal opening is 17 mm. wide; the interorbital space is 22 mm. wide.

Viewed from above, the skull of *Testudo praeextans* has its closest resemblances in the cranium of the Miocene *T. osborniana*, differing

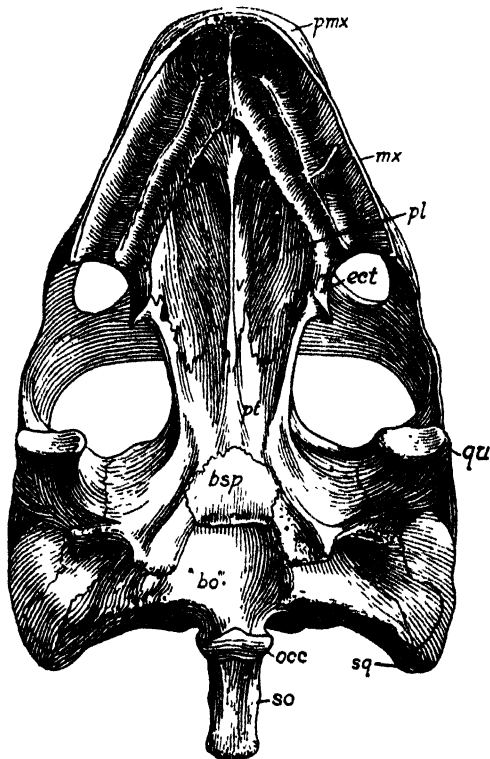


FIGURE 22.—Palatal view of the skull of *Testudo praeextans* Lambe (U.S.N.M. No. 15874): *bo*, basioccipital; *bsp*, basisphenoid; *ect*, ectopterygoid; *mx*, maxillary; *occ*, occipital condyle; *pl*, palatine; *pmx*, premaxillary; *pt*, pterygoid; *qu*, quadrate; *so*, supraoccipital; *sq*, squamosal; *v*, vomer. Natural size.

in its smaller size, the more abruptly truncated snout, the more bluntly pointed squamosal region, the longer supraoccipital process, and the straighter cutting edge of the maxillary. The orbit also has a greater anteroposterior diameter, being one-fourth the over-all length of the skull. The anteroposterior extent of the otic region measured across the paraoccipital and the prootic is 22 mm.

The incomplete skull of *Testudo thomsoni*, the only other Oligocene species in which the cranium is now known, differs from the skull

before me in having shorter prefrontals, smaller frontals, and longitudinal channels on the masticatory surfaces unequal in width. Whether these differences constitute stable characters that can be relied upon for their specific separation cannot be determined until more skulls are available.

The roof of the mouth is moderately vaulted and traversed along the midline by a sharp ridge (fig. 22), the anterior end of which abruptly widens where the vomer articulates with the premaxillaries and

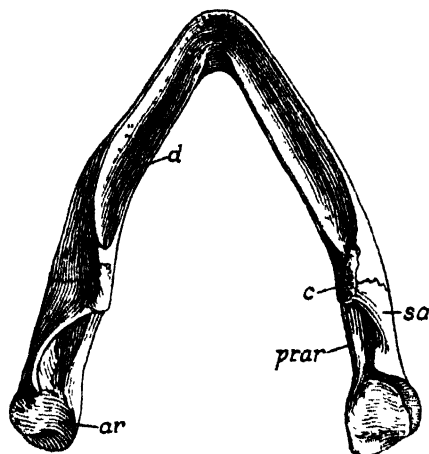


FIGURE 23.—Lower jaw of *Testudo praeextans* Lambe (U.S.N.M. No. 15874), superior view: *ar*, articular; *c*, coronoid; *d*, dentary; *prar*, prearticular; *sa*, surangular. Natural size.

maxillary bones. Posteriorly this vomerine ridge underlaps the pterygoid part of the ridge, which merges into the palatal surfaces of the pterygoid slightly in advance of their median union with the basisphenoid.

The masticatory surface of the maxillary is divided by a low median ridge that is received in a groove of the mandible. This ridge is bordered on each side by longitudinal grooves of about equal width. In this respect this specimen differs markedly from *Testudo thomsoni*, which has a very narrow inner groove and a widened outer groove. The inner ridge is unusually low, and it meets its fellow of the opposite side on the posterior border of the premaxillary. At the midline along the symphysis of the premaxillae there is a prominent longitudinal ridge, as in *Gopherus* and in some living species of *Testudo*. This ridge is absent in the skulls of other American fossil *Testudo* now known. It was the supposed absence of this ridge in front of the choanae that led Hay to use it as one of the important characters for distinguishing *Testudo* from *Stylemys*.<sup>1</sup>

<sup>1</sup> Hay, O. P., Fossil turtles of North America. Carnegie Inst. Washington Publ. 75, p. 397, 1908.

The lower jaw, as in *Testudo* generally, is massive and heavy. Its length from the symphysis to the angle is 59 mm., height at the coronoid process 59 mm., height at the symphysis 10.5 mm. The masticatory surface is traversed longitudinally by a deep groove. Inner cutting edge of the mandible is nearly as high as the outer. Inner cutting edge of the rami is separated by a notch at the symphysis; cutting edge not denticulated. The extent of the several elements forming the mandible is clearly shown in figures 21 and 23.

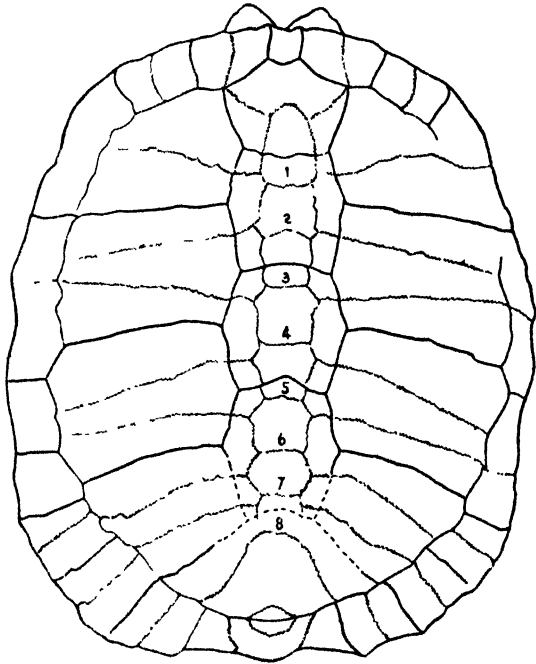


FIGURE 24.—Carapace of *Testudo praestans* Lambe, type (C. N. M. No. 8401): 1, 2, 3, 4, 5, 6, 7, 8, neurals 1–8, respectively. One-sixth natural size.

*Carapace*.—In the general contour of the carapace and plastron, but more especially in the depressed character of the shell as a whole, all these specimens are in close agreement with the type of the species. The carapaces of all are flattened on top in the vertebral region and when viewed from the side present a nearly straight profile except where they curve downward at the ends. This depression of the carapace, with the exception of *Testudo laticunea* Cope, appears to distinguish this species from all other North American members of the genus. Among the large land tortoises only *Testudo grandidieri* Vaillant, of northern Madagascar, has a somewhat similar depressed and flattened shell.

The four specimens under discussion show a considerable difference in size of the shell, as indicated in table 1.

TABLE 1.—Comparative measurements of carapaces of *Testudo praeextans*

Specimen	Greatest length	Greatest width	Greatest height	Sex	Width to length
	<i>Mm.</i>	<i>Mm.</i>	<i>Mm.</i>		<i>Percent</i>
C.N.M. No. 8401 (type)---	479	410	120	Female-----	85
U.S.N.M. No. 15878-----	485	392	140	Male-----	80
U.S.N.M. No. 16728-----	525	438	184	-----do-----	83
U.S.N.M. No. 16732-----	<sup>1</sup> 497	450	182	-----do-----	90
U.S.N.M. No. 15874-----	540	452	160	-----do-----	83

<sup>1</sup> Shortened by crushing.

The larger size of the National Museum specimens as compared with the type may be accounted for partly by difference in age and partly by sex. The hollowed-out plastra of the National Museum specimens clearly indicate them to be males, whereas the flattened plastron of the type of *T. praeextans* shows it to be a female. Among living land tortoises it is a well-established fact that the males of a species attain a larger size than the females. Furthermore, that the larger specimens (U.S.N.M. Nos. 15874 and 16732) are aged individuals is shown by the strong incurving of the pygal region (pl. 40, fig. 1; pl. 41, fig. 2), for it has been observed by Lord Rothschild,<sup>2</sup> in his study of the Galápagos tortoises, that "very old individuals of both sexes show an inclination often very strong, for the supracaudal to curve round towards and even under the posterior end of the plastron."

Viewed from above, all the specimens (pls. 38, 39), including the type, are very similar in having their anterior borders broadly rounded from side to side; the breadth of the shell decreases more rapidly toward the front than toward the back, and so the posterior half has a squarer outline than the anterior half. This is brought about chiefly by the enlargement of the peripherals. The posterior border may be described as angularly rounded, though this contour differs considerably with the age of the individual. The oldest specimens (Nos. 15874 and 16732) are more squarely truncate across the pygal region than the others, owing to the downward and forward deflection of this midportion of the shell.

The anterior peripherals in all specimens agree in being produced almost horizontally forward; the lateral ones continue the general convexity of the shell downward, whereas those more posteriorly flare outward and somewhat upward above the openings for the posterior extremities.

The nuchal, as shown by the measurements in table 2, is fairly constant in its extent and proportions. The same observation may be made of the pygal, suprapygal, and second suprapygal.

<sup>2</sup> Rothschild, L. W., Nov. Zool., vol. 22, p. 428, 1915.



TABLE 2.—*Comparative measurements (in millimeters) of nuchals, pygals, and suprapygals of Testudo praeextans*

Specimen	Nuchal		Pygal		Second suprapygal		First suprapygal	
	Maximum length	Maximum width	Maximum length	Maximum width	Maximum length	Maximum width	Maximum length	Maximum width
C.N.M. No. 8401 (type)	95	103	70	62	---	---	84	102
U.S.N.M. No. 15878	82	103	66	76	51	74	81	99
U.S.N.M. No. 16728	102	113	---	82	---	---	---	---
U.S.N.M. No. 16732	107	113	54	84	50	---	87	99
U.S.N.M. No. 15874	102	113	74	83	49	74	100	118

TABLE 3.—*Comparison of shape of neurals of Testudo praeextans*

Neural No.	C.N.M. No. 8401 (type)	U.S.N.M. No. 15878	U.S.N.M. No. 16732	U.S.N.M. No. 15874	U.S.N.M. No. 16728
1	Ovate	Ovate	Ovate	Hexagonal	Hexagonal
2	Hexagonal	Octagonal	Octagonal	do	Do.
3	Quadrangular	Quadrangular	Quadrangular	Quadrangular	Quadrangular
4	Hexagonal	Octagonal	Hexagonal	Hexagonal	Hexagonal
5	do	Hexagonal	do	do	Do.
6	do	do	do	do	---
7	do	do	do	do	---
8	do	do	do	do	---
9	do	do	---	---	---

The free border of the pygal in specimen No. 15874 differs from the others in being strongly toothed. The bifurcated first suprapygal in the type and in specimen No. 15874 is in contact with the pygal and eleventh peripheral, whereas in the other three specimens it articulates only with the eleventh peripheral.

In the shape of the neural bones three features are found common to all available specimens: (1) The first neural is the longest of the series; (2) the third neural is always quadrangular; (3) the fifth to eighth neurals, inclusive, are hexagonal. One individual, No. 15878, has two octagonal neurals, the second and fourth; one, No. 16732, has only the second neural octagonal; and No. 16728 has none octagonal. In most species of *Testudo* there are two octagonal neurals, the second and fourth, but a series of specimens of other species might show them to be equally variable as in *T. praeextans*. The variation in the form of the neurals in *T. praeextans* is shown in table 3.

In discussing the neurals of *T. laticuneae*, Hay<sup>3</sup> says, "The neurals have not attained so high a degree of differentiation of form as they have in most of the species of the genus." If reference is made to the absence of octagonal neurals the statement is true of the types of

<sup>3</sup> Hay, O. P., Carnegie Inst. Washington Publ. 75, p. 403, 1908.

both *T. laticuneae* and *T. praeextans*. In my judgment the difference found in the neural bones of the specimens under consideration represents individual variations well within the species.

Specimen U.S.N.M. No. 15878 (pl. 38, fig. 2) has an extra neural, or nine in all. It is quite evident from an examination of the specimen that the extra element has developed between number 7 and the last, which is without corresponding costals. Lambe<sup>4</sup> has described a greater deviation of carapace structure in a specimen of *Stylemys nebrascensis*, which has not only an extra neural but also a ninth pair of costal bones and an additional vertebral scute. This same authority points out that the type of *Stylemys culbertsoni* likewise has an additional neural.

The variation in shape of the neurals has brought about a corresponding variation in the proportions of these bones, as shown in table 4. In *Testudo praeextans* the first neural is consistently the longest of any of the series.

The costal plates in all these specimens are highly modified, and as usual in *Testudo* the second, fourth, and sixth are widened distally and narrowed proximally, while the third and fifth are narrowed distally and widened at the proximal ends.

The sulci in most of the specimens are narrow and shallowly impressed, and where they reach the free edges of the peripherals there is usually a small obtuse projection or mucro.

In the type of *Testudo praeextans* the sulcus forming the posterior boundary of the third vertebral curves strongly forward at the center where it crosses the fifth neural, as in U.S.N.M. Nos. 15878, 16728, and 16732. In specimen No. 15874, however, the sulcus crosses the sixth neural as in the type of *T. laticunae* Cope.

The proportions of the vertebrae are variable, as shown in table 5. In the type of *T. laticuneae* and No. 15878 the fifth vertebral is the longest of the series, whereas in No. 15874 the first is the longest. In the type of *T. laticuneae* and No. 15874 the first vertebral is longer than wide, but in the type of *T. praeextans* and No. 15878 this same vertebral is wider than long. No. 15874 is the only specimen having the third vertebral longer than wide.

The most distinctive feature of the plastron is the extended epiplastral lip that always projects well beyond the line of the front margin of the carapace. It was the "marked prominence and size of the epiplastral lip" that Lambe<sup>5</sup> stressed as the most important character for distinguishing *Testudo praeextans*, a character to which the specific name refers. In the light of these additional specimens it is clearly shown that the extent and shape of this lip constitute one of the more stable characters of this species.

<sup>4</sup> Lambe, L. M., *Ottawa Nat.*, vol. 27, p. 63, 1913.

<sup>5</sup> Lambe, L. M., *Ottawa Nat.*, vol. 27, pp. 57-61, pls. 4, 5, 1913.

The relative proportions of the lobes and other measurements of the plastron are clearly shown in table 6.

TABLE 4.—Comparative measurements (in millimeters) of neurals of *Testudo praeextans*

Specimen	Length									Width								
	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9
C. N. M. No. 8401 (type)-----	68	40	41	37	36	34				44	47	34	48	45	44	44		
U.S.N.M. No. 15878-----	62	42	37	39	36	34	41	15	38	33	42	40			50	49	35	39
U.S.N.M. No. 16732-----	67	46	43	41	55	36	38	46		34	49	41	49	45	58	57	38	
U.S.N.M. No. 15874-----	76	48	44	39	42	34	35	51		46	51	39	42	51	46	55	53	
U.S.N.M. No. 16728-----	76	43	42	54						48	55	43	54					

TABLE 5.—Comparative measurements (in millimeters) of vertebrals of *Testudo praeextans*

Specimen	Length					Width				
	1	2	3	4	5	1	2	3	4	5
C. N. M. No. 8401 (type)-----	100	77	78			97	82	88	82	10
U.S.N.M. No. 15878-----	100	82	81	103	105	110	79	86	87	17
U.S.N.M. No. 16728-----	103	91	86			113	91	103		
U.S.N.M. No. 16732-----	120	97	90	109	106	114	91	101	97	21
U.S.N.M. No. 15874-----	122	109	112	86	117	100	86	90	89	18

TABLE 6.—Comparative measurements (in millimeters) of plastra of *Testudo praeextans*

Measurement	C. N. M. No. 8401	U.S.N.M. No. 15878	U.S.N.M. No. 16732	U.S.N.M. No. 15874	U.S.N.M. No. 16728
Greatest length of plastron-----	493	495	540	580	-----
Length of anterior lobe-----	163	154	178	187	191
Width of anterior lobe-----	229	205	258	243	-----
Length of posterior lobe-----	147	135	145	155	-----
Width of posterior lobe-----	239	225	245	270	-----
Length of epiplastral lip-----	72	60	71	85	76
Width of lip at base-----	97	81	95	102	97
Extension of epiplastral lip be- yond border of carapace-----		47	72	88	75
Depth of posterior notch-----	40	34	39	48	-----

The free borders of the plastra in all five specimens are acute, except those parts of the borders adjacent to the notches, which are thickened and rounded. The posterior lobes are terminated behind in two broadly rounded apices separated on the median line by wide V-shaped notches. The borders of the apices are usually slightly toothed. Likewise, the anterior ends of the epiplastral lips are notched at the center and the borders are toothed with six blunt teeth, except in the type of *Testudo praeextans*, as shown in figure 25.

The entoplastra in all the specimens except No. 15878 are in agreement in having pointed anterior ends and a broad somewhat rounded posterior border, with the gular scutes overlapping the front of this bone.

There is some variation in the extent of the plastral scutes in these specimens, as shown in table 7.

*Pelvis.*—The pelvis of specimen No. 15874 is in an unusually perfect state of preservation, the two halves being coalesced along the median

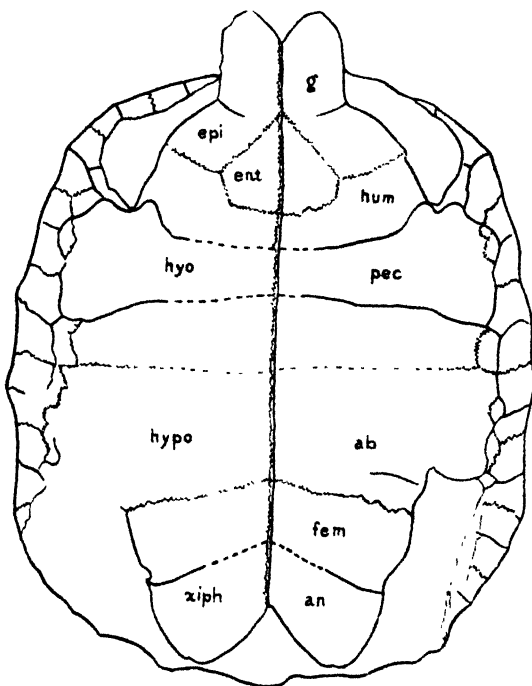


FIGURE 25.—Plastron of *Testudo praeextans* Lambe, type (C. N. M. No. 8401): *ab*, abdominal scute; *an*, anal scute; *ent*, entoplastron; *fem*, femoral scute; *g*, gular scute; *hum*, humeral scute; *hyo*, hyoplastral bone; *hypo*, hypoplastral bone; *pec*, pectoral scute; *xiph*, xiphiplastral bone. One-sixth natural size.

line, as represented in figures 26 and 27. The pelvis of No. 16732 is also well preserved, but the two halves were separated along the median suture. Except for minor details these two pelvises are in close agreement and thus are probably typical of *Testudo praeextans*.

Of these two turtle specimens of nearly equal size and presumably of equivalent age one has the pelvic sutures coalesced, while in the other these same sutures are open, thus indicating that the relative age of an individual cannot always be judged by the non-coalescence of the sutural junctures.

The anterior extremities of the pubes are complete in specimen No. 15874, which shows that border to be broadly rounded, thus

suggesting that Hay may have erred in restoring this missing end in the pelvis of the type of *T. laticunea* as being bilobed.<sup>6</sup> The un-

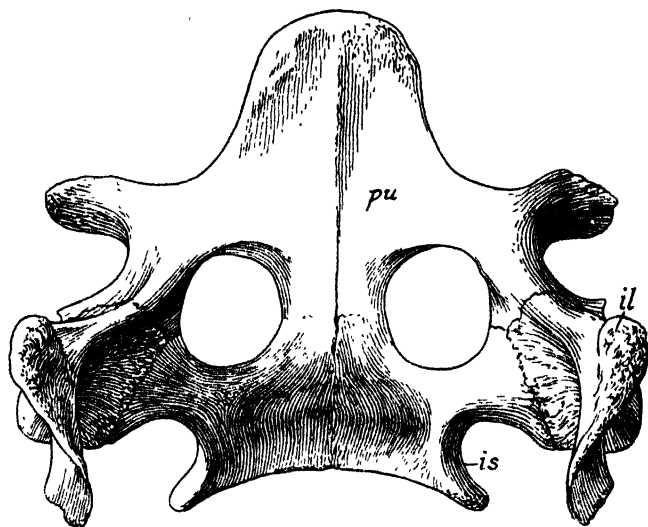


FIGURE 26.—Pelvis of *Testudo praetextans* Lambe (U.S.N.M. No. 15874), viewed from above: *il*, ilium; *is*, ischium; *pu*, pubis. One-half natural size.

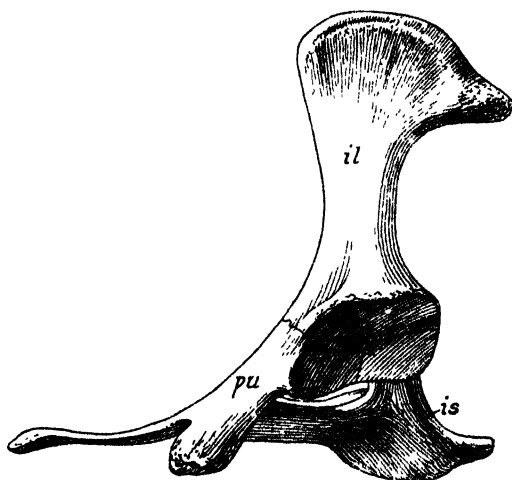


FIGURE 27.—Pelvis of *Testudo praetextans* Lambe (U.S.N.M. No. 15874), viewed from the left side: *il*, ilium; *is*, ischium; *pu*, pubis. One-half natural size.

usual length of the anterior pubic process, forward of the lateral pubic tuberosities, appears to be a distinctive feature of this species. The apices of the ischial tuberosities are bluntly pointed and 80 mm. apart.

<sup>6</sup> Hay, O. P., Carnegie Inst. Washington Publ. 75, p. 404, fig. 512, 1908.

Careful comparison made of the other skeletal parts preserved with these various specimens, with each other and with homologous bones of other species of *Testudo*, failed to disclose, except that of size, differences that would be of assistance in specific differentiation. On that account there seems no point in illustrating or describing these parts here, although most of the bones present are in excellent preservation. In order, however, that there may be a record of relative proportions between carapace and limb bones, a table of measurements of the more important elements of the specimens here discussed is given (table 8).

TABLE 7.—Comparative measurements (in millimeters) of plastral scutes of *Testudo praeextans*

Scute (length on the midline)	C. N. M. No. 8401 (type)	U. S. N. M. No. 15878	U. S. N. M. No. 16732	U. S. N. M. No. 15874	U. S. N. M. No. 16728
Gular.....		93	80		92
Humeral.....			103	102	
Pectoral.....	34		43	44	
Abdominal.....		135	147	143	
Femoral.....		63	58	72	
Anal.....		50	46	51	

TABLE 8.—Comparative measurements (in millimeters) of girdle and limb bones of *Testudo praeextans*

Measurement	U. S. N. M. No. 15878	U. S. N. M. No. 16732	U. S. N. M. No. 16728	U. S. N. M. No. 15874
Greatest length of coracoid.....		88	82	74
Greatest width at inner end.....		77	65	76
Greatest length of scapula from tip to tip.....		153	151	<sup>1</sup> 150
Greatest length of humerus.....		155	153	157
Greatest length of ulna.....		99		99
Greatest length of radius.....	80	98		97
Greatest length of femur.....				113
Greatest length of tibia.....		78	77	82
Greatest length of fibula.....			80	82

<sup>1</sup> Estimated.

*Feet*.—All four of the National Museum specimens considered in the preceding pages have various parts of the carpi, tarsi, and feet present, but only in No. 15878 are the bones preserved at all in articulation. The right forefoot, with carpus and radius, although lacking a few elements, has the others articulated in normal relationship as shown in plate 44, figure 2. This foot clearly shows the presence of five well-developed digits, each having a claw. The small blocklike bones of the carpus are but little disturbed and can be quite certainly identified. The ulnare and intermedium furnish the main articulation of the ulna, which is missing. Occupying the position of the radiale at the distal end of the radius is an angular blocklike element that, following Baur

and Williston,<sup>7</sup> we may identify as centrale 1. Its outer side is in juxtaposition to a smaller pentagonal bone regarded as centrale 2. These two centralia although distinct elements in this individual are often found fused into a single bone, and this appears to have happened in specimen No. 15874. Williston, in the book cited, observes, "Among terrestrial tortoises the radiale has disappeared until nothing is left of it but a nodule of cartilage united with the first centrale which has usurped its place." Hay, however, in his "Fossil Turtles of North America," continues to regard the first centrale as the radiale.

The fifth carpale (pl. 44, fig. 2, C<sub>5</sub>) is present and remains in articulation with metacarpal 5. Carpalia 3 and 4 are missing. The third digit lacks its metacarpal, and a phalange is missing from the fifth digit; otherwise the foot is complete. Comparison of these wrist and foot bones with those of the living Galápagos *Testudo* of comparable size shows a close correspondence in form, as well as in the arrangement of the individual elements.

The hind foot of No. 15878 contributes nothing new to our knowledge of the pes of *Testudo*.

#### SUMMARY

In the original description of *Testudo praeextans* Lambe called attention to the close similarity in the form of the epiplastral beak to that of *T. thomsoni* but concluded that the "much greater proportionate size of the epiplastral lip and differences throughout of the elements forming the lobe" were sufficient to indicate their specific distinctness.

In view of the very fragmentary character of the type of *T. thomsoni*, and especially of the considerable variation in the form of the anterior lobe as shown by the present specimens, it would now appear that Lambe was not justified in establishing the new species *T. praeextans*. On plastral parts alone I should unhesitatingly regard *T. praeextans* to be a synonym of *T. thomsoni*, which has priority by several years. However, when the skulls are compared, differences in proportion of the elements forming the skull roofs, and the different widths of the channels on the triturating surfaces, strongly suggest that the discovery of more complete materials of *T. thomsoni* may disclose other and more important distinctive characters. For the present, therefore, it seems desirable to continue the use of both names.

In the preliminary study of the present materials it was first thought that these specimens could not be specifically distinguished from *Testudo laticuneus* Cope and that such differences as existed might be attributed to the female sex of the type of that species. This idea was abandoned, however, with the discovery that the Wyoming

<sup>7</sup> Williston, S. W., The osteology of the reptiles, p. 179, 1925.

specimens all had broadly rounded anterior carapace borders and prominent epiplastral lips with parallel sides, as contrasted with the more truncate carapace border and wedge-shaped epiplastral lip in *T. laticuneae*.

This study of a number of *Testudo* specimens from a restricted area and apparently of a single species shows enough variation in shell structure to cast much doubt on the validity of many described species, especially those founded on fragmentary materials. Furthermore, it raises the perplexing question as to what features are to be relied on for specific differentiation. It has been demonstrated (pls. 38-41) that the neural, costal, and other elements forming the carapace, as well as the form and proportions of the vertebral and plastral scutes, are seldom in themselves sufficiently constant in shape and proportion to be relied on for specific designation.

Whether characters of the skull in fossil *Testudo* will be found more stable can only be determined when a series of crania is available for comparison, and at this time no such series exists. It is in the general form of the carapace and plastron and especially in the development of epiplastral beak that most reliance has been placed in diagnosing the present species.

#### TESTUDO LATICUNEA Cope

##### PLATES 42, 43

*Testudo laticuneae* COPE, Paleont. Bull. No. 15, p. 6, 1873.—HAY, Carnegie Inst. Washington Publ. 75, p. 402, pl. 67, figs. 1, 2, 1908.

Two specimens (U.S.N.M. Nos. 15854 and 16731) in the Oligocene collections from eastern Wyoming are identified as pertaining to *Testudo laticuneae* Cope, the first recorded occurrence of the species in this area. These specimens are remarkably alike (cf. pls. 42 and 43) both in size and structural detail, a condition calling for comment, as anyone will agree who has had occasion to study a series of *Testudo* specimens.

The type of *T. laticuneae* is an essentially complete shell, with some of the internal skeleton, and was found in the Oligocene badlands along the head of Horse Tail Creek in northeastern Colorado. Two other specimens, one from the *Titanotherium* beds (Chadron) of South Dakota and one from the *Oreodon* beds (Brule) of Sioux County, Nebr., were identified by Hay<sup>1</sup> as pertaining to this species. These together with the two in the U. S. National Museum comprise all the known materials of the species.

Specimen U.S.N.M. No. 15854 consists of a nearly complete carapace and plastron (pl. 43), left humerus, proximal end of right; left ulna, radius, and part of forefoot; incomplete right scapula, left

<sup>1</sup> Hay, O. P., Carnegie Inst. Washington Publ. 75, pp. 404-405, 1908.



coracoid; left femur, tibia, fibula, and portion of hind foot. It was collected by C. W. Gilmore on the Thomas Ranch, Niobrara County, Wyo., in 1932. Specimen U.S.N.M. No. 16731 consists of a complete carapace and plastron (pl. 42). It was collected 1 mile northeast of Whitman Postoffice, Niobrara County, Wyo., by George B. Pearce in 1942. Both of these specimens are from the Brule division of the Oligocene.

In size and general contour of the shell these specimens are in close agreement with the type, as shown by the measurements given in table 9.

TABLE 9.—Comparative measurements (in millimeters) of carapace and plastron of *Testudo laticuneus*

Measurement	Type specimen	U.S.N.M. No. 15854	U.S.N.M. No. 16731
Greatest length of carapace.....	408	436	435
Greatest width of carapace.....	356	332	340
Greatest length of plastron.....	440	440	443
Greatest length of anterior lobe.....	132	132	137
Greatest width of anterior lobe.....	200	202	203
Greatest length of posterior lobe.....	120	110	110
Greatest width of posterior lobe.....	200	193	196
Greatest width of bridge.....		200	197
Greatest width of anterior lip at gular notch....	87	90	88

Specimens U.S.N.M. Nos. 15854 and 16731 are practically free from distortion and thus give a true picture of the normal shell. It will be noted in the table of measurements that the Wyoming carapaces are considerably narrower than that of the type. This difference may be partly due to the crushing to which the type has been subjected. In cross section at midlength the shells of Nos. 15854 and 16731 are evenly rounded from side to side, whereas the type is said to be flattened on top. All three, however, can be classed as having a depressed style of shell, and all are of female sex, as shown by the flatness of their plastra.

Other minor differences observed between these two specimens and the type fall well within the variations expected in individuals of a single species.

The skeletal parts preserved with the shell of U.S.N.M. No. 15854 have been carefully compared with the homologous bones of *T. praeextans* and other species of *Testudo*, but except for their smaller size no other characters for distinguishing between them were discovered.

Hay<sup>9</sup> has pointed out in his study of the type of *T. laticuneus* that the "neurals have not attained so high a degree of differentiation as they have in most species of the genus." Although the complete neural series cannot be traced out in either specimen, the correctness of the

<sup>9</sup> Hay, O. P., Carnegie Inst. Washington Publ. 75, p. 403, 1908.

above conclusion is verified by these new materials. Specimen No. 16731 appears to show the second neural to be octagonal as it is in the South Dakota specimen studied by Hay.<sup>10</sup>

The slight variation in the vertebrals of the three specimens discussed here is shown by the measurements given in table 10.

TABLE 10.—Comparative measurements (in millimeters) of vertebrals of *Testudo laticuneus*

Specimen	Length					Width				
	1	2	3	4	5	1	2	3	4	5
Type specimen.....	86	80	81	75	90	102	80	85	82	135
U.S.N.M. No. 15854.....	78	89	83	83	88	94	82	82	---	133
U.S.N.M. No. 16731.....	91	77	78	78	90	94	74	78	79	142

TABLE 11.—Comparative measurements (in millimeters) of epiplastral beak of *Testudo quadrata*

Measurement	Type (A.M.N.H.)	U.S.N.M. No. 16737
Width of beak at base.....	120	135
Length of beak from gular groove.....	70	54
Thickness of beak at base.....	29	41

The combination of characters that appear to distinguish *Testudo laticuneus* Cope is as follows:

Diagnosis: Carapace depressed with truncated anterior border, but slightly rounded from side to side across the vertebral region; prominent epiplastral lip, projecting beyond the borders of the carapace with converging sides; neurals less differentiated than in most species of the genus, and usually without those of octagonal form.

#### TESTUDO QUADRATA Cope

#### PLATE 44, FIGURE 1

*Testudo quadratus* COPE, The Vertebrata of the Tertiary formations of the West, p. 764, pl. 61, fig. 5, 1884.

*Testudo quadrata* HAY, Bibliography and catalogue of the fossil Vertebrata of North America, p. 451, 1902; Carnegie Inst. Washington Publ. 75, p. 410, figs. 532, 533, 1908; Second bibliography and catalogue of the fossil Vertebrata of North America, vol. 2, p. 104, 1930.

A third species of *Testudo* occurring in the Indian Creek Basin area is represented in the National Museum Oligocene collection by an epiplastral beak (U.S.N.M. No. 16737), shown in plate 44, figure 1. This specimen was collected from the Brule, about 1 mile north of Whitman Postoffice, Niobrara County, Wyo., in 1942.

<sup>10</sup> *Ibid.*, p. 404.

The quadrate form of this beak with diverging lateral edges is more like that of *T. quadrata* Cope than of any other species, but it differs in having the gulohumeral sulci running backward and inward to meet on the median line instead of directly across this bone at right angles to the midline, as in the type of the species. This feature, stressed by both Cope and Hay, is so at variance with all other known species of *Testudo*, both living and extinct, that it leaves one wondering if it is not an abnormal condition peculiar only to that individual.

Specimen No. 16737 is larger than the type, as shown by the measurements given in table 11.

With the possible exception of length, the other differences observed between the two specimens may be regarded as individual variations. The beak is shorter than that of the type although exceeding it in all other dimensions. Regardless of the question of doubt that this difference may engender as to its proper specific assignment, this fragmentary specimen certainly indicates the presence in the Brule of the Hat Creek Basin of a third species of *Testudo*.

#### NOTE ON THE GEOLOGICAL DISTRIBUTION OF TESTUDO IN NORTH AMERICA

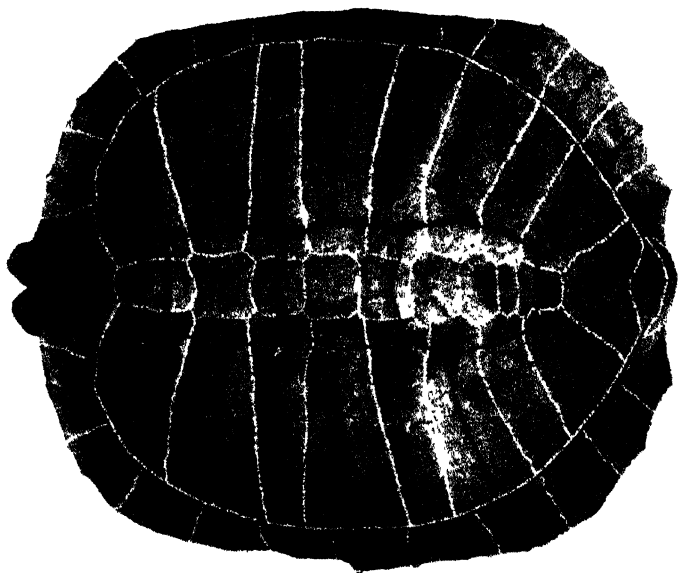
In the "Fossil Turtles of North America," p. 397, 1908, Hay lists six species of Oligocene *Testudo* as occurring in the *Oreodon* beds (Brule) and two as coming from the *Titanotherium* beds (Chadron), as follows:

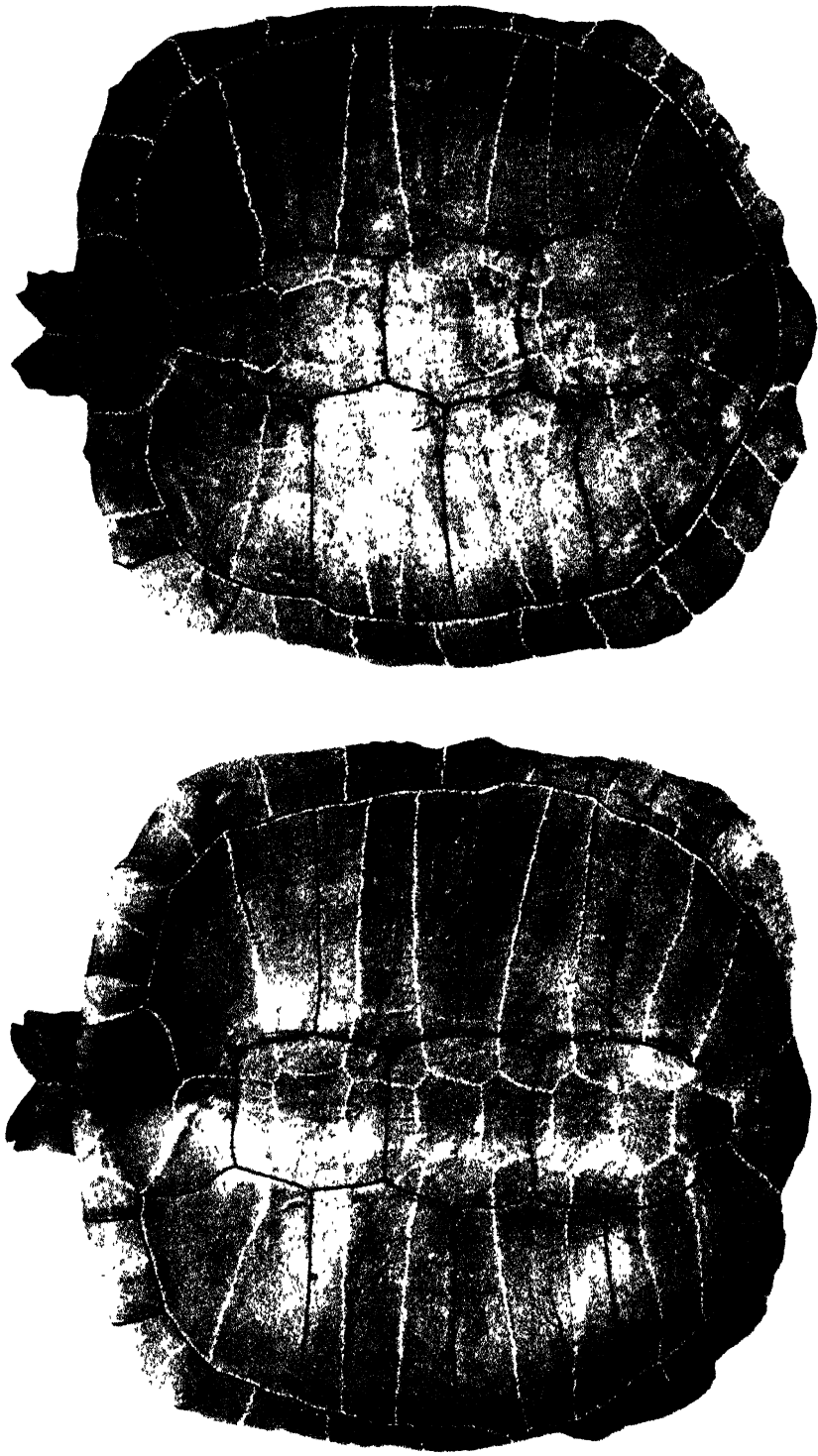
BRULE	CHADRON
<i>Testudo amphithorax</i> Cope	<i>T. brontops</i> Marsh
<i>T. cultrata</i> Cope	<i>T. exornata</i> Lambe
<i>T. laticunea</i> Cope	
<i>T. ligonia</i> Cope	
<i>T. quadrata</i> Cope	
<i>T. thomsoni</i> Hay	

In a subsequent publication, "Second Bibliography and Catalogue of the Fossil Vertebrates of North America," Hay assigned all the Brule species to the Chadron. One is at a loss to understand whether this change was made on the basis of new information or whether it was a slip of the pen.

In view of the recognition of two, if not three, of the species in undoubted Brule deposits, it would appear to show the original geologic assignment was correct. That some of these species may have persisted from the Chadron into the Brule is suggested by a specimen in the Yale Museum from the *Titanotherium* beds, which Hay<sup>11</sup> identified as belonging to *Testudo laticunea*. That such was the case needs additional verification. This assertion is made on the fact that the commonest of all land tortoises of the Brule, *Stylomys nebrascensis*, has never been recognized as occurring in the Chadron.

<sup>11</sup> Hay, O. P., Carnegie Inst. Washington Publ. 75, p. 404, 1908.

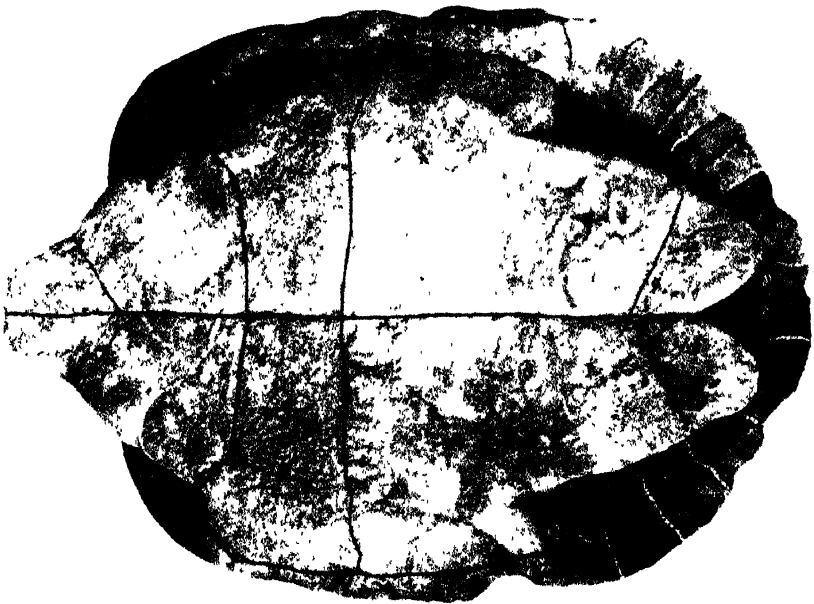
[illegible]



*Testudo praeextans*, Lambe. Left, carapace, U S N M N 16732, 27; Right, carapace, U S N M N 16728. One-third natural size.

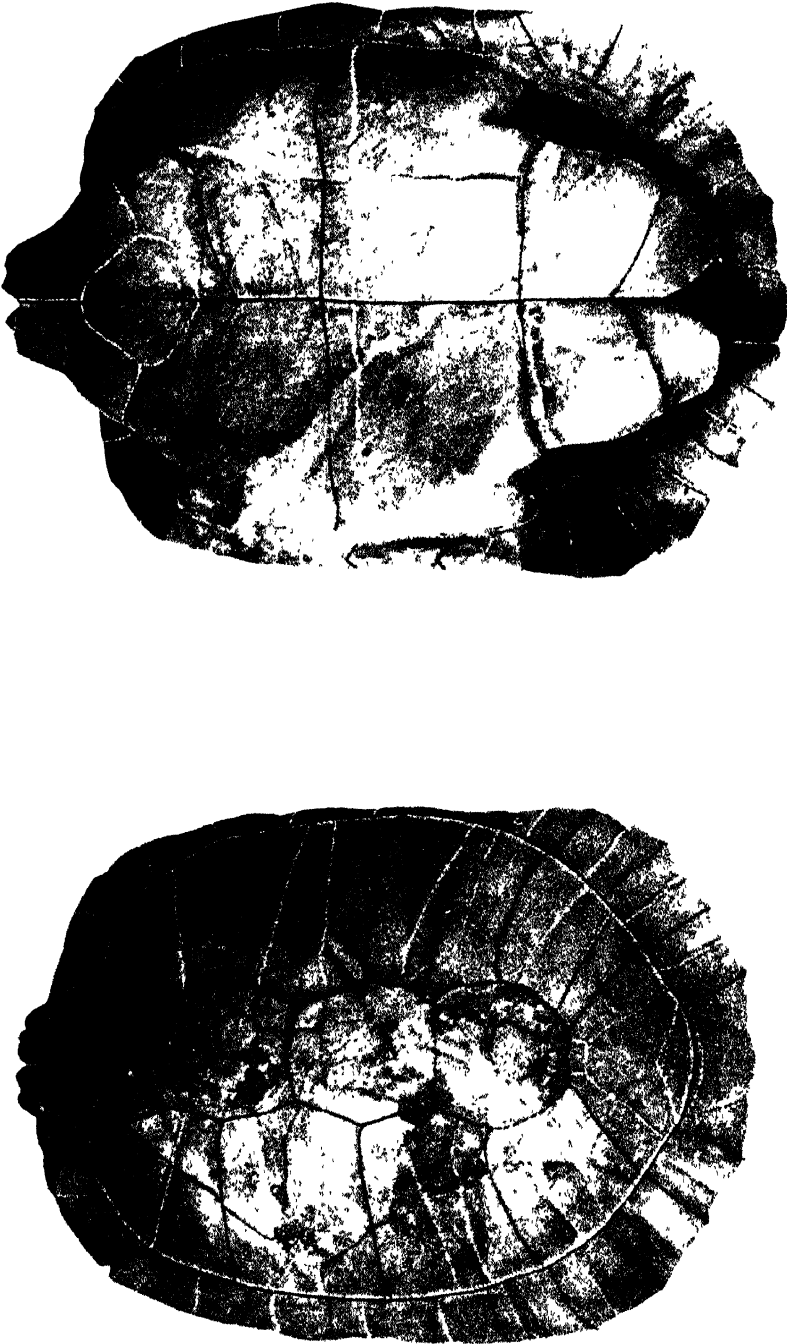




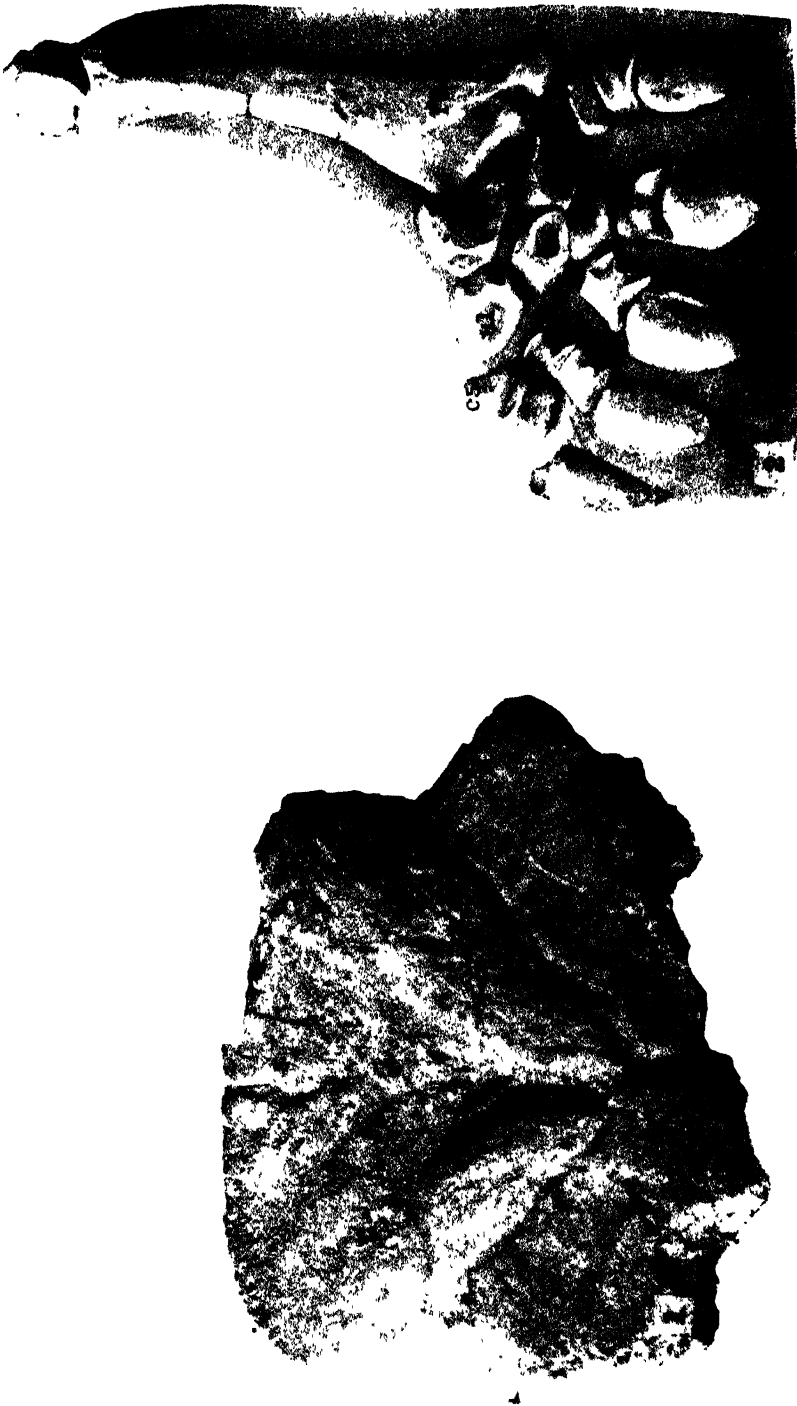


*Testudo 13004 Cope USNM 16751. Dorsal and ventral views. On right, not enlarged.*





*Ternstroemia* Core, U S N M No 1554. Left, Catalogue, right, Original natural size.



1, Epiploastral beak of *Trochiloides quadricornis* (Cope), U. S. N. M. No. 16737, vertical view, about one-half natural size.  
2, Right forelimb and radius of *Trochiloides quadricornis* (Cope), U. S. N. M. No. 15778. C, C, C, carpal 1, 2, and 3, respectively; I, I, I, intermediate radius, ulna, and V, digits 1 to 5, respectively, shown in place as found. Natural size.



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EIGHT NEW SPECIES OF CHALCID-FLIES OF THE GENUS  
*PSEUDAPHYCUS* CLAUSEN, WITH A KEY TO THE  
SPECIES

By A. B. GAHAN

THE species of chalcid-flies of the genus *Pseudaphycus* Clausen (family Encyrtidae) are apparently all parasites of pseudococcine scale insects, and some of the species are known to be of considerable economic importance through the control they exercise over their hosts. *P. utilis* Timberlake is credited with having all but exterminated *Pseudococcus nipae* (Maskell) in Hawaii, and the new species *malinus* (described on a subsequent page of this paper), which was introduced into the eastern United States from Japan to combat *Pseudococcus comstocki* (Kuwana), apparently gives promise of bringing that serious orchard pest under control.

The genus is widely distributed. Species are now known to occur in Austria, Spain, Canary Islands, Cuba, Puerto Rico, the United States from New Jersey to California, Hawaii, Korea (Chosen), and Japan.

*Pseudaphycus* belongs to the group of genera related to *Aphycus* Mayr. It may be distinguished from *Aphycus* as well as most of the other related genera by the fact that it has only five, instead of six, segments in the antennal funicle. It is most closely related to *Bothriocraera* Timberlake and *Acerophagus* Smith, both of which have the funicle 5-segmented. It may be separated from *Bothriocraera* by the dull sculpture of its frontovertex and thoracic dorsum and by the fact that it is never shining black in color. As pointed out by Mercet (Bull. Ent. Res., vol. 28, p. 317, 1937), the differences between *Pseudaphycus* and *Acerophagus* are very slight. About the only real differences seem to be that in *Acerophagus* the frontovertex is less than

twice as long as wide, the ocellar triangle is more or less obtuse, and the antennae are unicolorous and always pale, while in *Pseudaphycus* the frontoververtex is nearly always two or more times as long as broad, the ocelli are arranged in an equilateral or acute triangle, and the antennae are always contrastingly colored with the scape, pedicel, and at least some of the funicular segments black or fuscous and the club white.

The species of *Pseudaphycus* offer very few good characters for their separation. Slight differences in sculpture are hard to define and differences in color consist largely of differences in shades of yellow, since all the species are yellowish sometimes varied with admixtures of blackish or fuscous. The following key to species is offered as an aid to identification but should be supplemented by comparison with types or authentically determined specimens whenever possible:

#### KEY TO THE DESCRIBED SPECIES OF PSEUDAPHYCUS

##### FEMALES

1. Pedicel of antenna as long as or longer than first three segments of funicle combined, funicular segments from first to last successively increasing in width and all more or less transverse..... 2  
     Pedicel of antenna not longer than first two funicular segments combined; first funicular segment small, transverse, narrower than pedicel; segments 2 to 5 of funicle subquadrate, subequal, and each a little broader than pedicel..... 1 *meritorius*, new species
2. Ovipositor exerted one-fifth to nearly one-half length of abdomen..... 3  
     Ovipositor extending barely beyond apex of abdomen, at most distinctly less than one-sixth length of abdomen..... 2. *prosopidis* Timberlake
3. Wings hyaline; scape not expanded beneath..... 4  
     Wings at least faintly fuscous; scape often but not always somewhat thickened or slightly expanded beneath..... 5
4. General color pale lemon-yellow; hairs on mesoscutum white; ocellar triangle rather small and nearly equilateral; ovipositor exerted about one-third length of abdomen..... 3 *graminicola* Timberlake  
     General color bright orange-yellow; hairs on mesoscutum dark brown or blackish; ocellar triangle obviously acute and unusually large; ovipositor exerted about one-fifth length of abdomen..... 4. *utilis* Timberlake
5. Forewing fuscous with a more or less distinct paler hyaline or subhyaline transverse streak beyond apex of stigmal vein; scape obviously a little thickened or broadened..... 6  
     Forewing uniformly fuscous or subfuscous, without a paler transverse streak; scape usually slightly thickened but sometimes cylindrical..... 9
6. Anterior ocellus at center of frontoververtex; speculum of forewing not interrupted; mesoscutum, axillae, and scutellum bright orange-yellow, with a conspicuous narrow transverse band of black at anterior margin of mesoscutum..... 5. *websteri* Timberlake  
     Anterior ocellus distinctly above center of frontoververtex; speculum of forewing interrupted a little behind middle; mesoscutum, axillae, and scutellum more or less dusky orange to blackish yellow, anterior margin of mesoscutum with suture sometimes blackish but never forming a conspicuous and well-defined transverse band..... 7

7. Mesoscutum, axillae, scutellum, and abdomen blackish yellow; lateral borders of mesoscutum white; posterior ocelli as far from anterior ocellus as from margin of occiput; inner orbits parallel for whole length of frontovortex. 6. *maculipennis* Mercet
- Mesoscutum, axillae, and scutellum dusky orange-yellow; lateral borders of mesoscutum not white; posterior ocelli a little more distant from anterior ocellus than from margin of occiput; inner orbits diverging very slightly below----- 8
8. Frontovortex about two and one-half times as long as broad; head and thorax dorsally rather pale orange-yellow, axillary sutures of metanotum usually not blackish----- 7. *angelicus* (Howard)
- Frontovortex fully three times as long as broad; head and thorax dorsally a deeper shade of orange-yellow mixed with blackish, and axillary sutures brownish black.----- 8. *abstrusus*, new species
9. Middle and hind tibiae each with two fuscous or blackish bands----- 10
- Middle and hind tibiae without fuscous bands----- 12
10. Frontovortex as broad as long or somewhat broader than long; ocelli in an equilateral triangle; dorsum of thorax dirty yellow; antenna fuscous with first funicular segment and club white----- 9. *austriacus* Mercet
- Frontovortex twice to two and one-half times as long as broad; ocellar triangle at least slightly acute; dorsum of thorax orange-yellow, antennal scape yellowish below, brown above; pedicel and funicle brownish or fuscous, fifth funicular segment and club white----- 11
11. Ocellar triangle distinctly acute, posterior ocelli about half as far from each other as from anterior ocellus; speculum of forewing interrupted below middle----- 10. *orientalis* Ferriere
- Ocellar triangle nearly equilateral; posterior ocelli only slightly closer to each other than to anterior ocellus; speculum of forewing not interrupted. 11. *malinus*, new species
12. Last two segments of funicle (sometimes entire funicle) and club white, first three segments of funicle usually fuscous; frontovortex unusually narrow, fully three times as long as broad; ocelli in a very acute triangle, posterior pair separated by about diameter of an ocellus; ovipositor one-third to half as long as abdomen----- 12. *angustifrons*, new species
- Entire funicle black or at least fuscous; frontovortex at least a little broader; ocellar triangle less acute and posterior pair of ocelli separated by more than diameter of an ocellus; ovipositor usually shorter----- 13
13. Mesoscutum, scutellum, and axillae weakly sculptured, distinctly shining; dorsum of thorax dirty yellowish or grayish in color; antennal club blackish basally----- 14
- Mesoscutum, scutellum, and axillae finely and densely sculptured, dull; dorsum of thorax orange-yellow; antennal club entirely white----- 15
14. Scape of antenna obviously a little thickened or expanded beneath; ovipositor exerted one-third length of abdomen; speculum of forewing uninterrupted. 13. *mundus*, new species
- Scape of antenna not obviously expanded; ovipositor about one-fifth length of abdomen; speculum at least partially interrupted a little behind middle. 14. *limatus*, new species
15. Anterior margin of face narrowly dark brown or blackish, forming a dark transverse line between bases of mandibles; occiput except around margins black or blackish, anterior face of pronotum mostly black; suture between pronotum and mesoscutum blackish; tegula pale at base, blackish apically; abdomen dorsally mostly blackish; posterior tibiae often with two fuscous bands----- 11. *malinus*, new species

- Anterior margin of face without a dark line between bases of mandibles; head and thorax dorsally bright orange-yellow without any blackish markings; tegula white; abdomen with four rather definite dark transverse bands, one of which connects vibrissal plates, one basad of this and two apicad of it; hind tibiae not banded..... 16
16. Frontovortex bright orange-yellow and very finely granulosely sculptured with only very faint indication of alveolation even under high magnification..... 15. *meracus*, new species
- Frontovortex paler, dilute orange-yellow, entire surface covered with fine but very distinct facetlike punctures..... 16. *alveolatifrons*, new species

1. *PSEUDAPHYCUS MERITORIUS*, new species

The subquadrate second to fifth segments of the funicle distinguish this species from all other species treated here.

*Female*.—Length 0.92 mm. Frontovortex, mesoscutum, axillae, and scutellum slightly dusky orange-yellow; head (except frontovortex), tegulae, pronotum, all pleura, and sterna and all legs yellowish white; propodeum fuscous; abdomen dorsally yellowish with four transverse fuscous bands, the anterior two bands coalesced at the lateral margins of abdomen and enclosing an ellipsoidal area between the cerci, the posterior two bands straight; abdomen beneath fuscous to blackish medially with the margins pale, ovipositor pale at base, darker apically; eyes black; ocelli dark red; antennal scape pallidofuscous; pedicel and entire funicle black or blackish; club white; wings uniformly faintly fuscous, or subhyaline; marginal and stigmal veins dark fuscous, submarginal vein pale.

Frontovortex a little less than twice as long as broad, granulosely punctate; inner orbits parallel; ocelli in an equilateral triangle; anterior ocellus situated only slightly above middle of frontovortex; lateral ocellus less than its own diameter from margin of eye and about its own diameter from occipital margin; eyes clothed with short hairs. Antenna clavate; scape not expanded beneath, five to six times as long as thick; pedicel nearly twice as long as thick and less than one-third as long as scape; first funicular segment small, narrower than pedicel; segments 2 to 5 of funicle subequal and subquadrate, and each a little thicker than pedicel; club a little thicker than funicle and approximately as long as the four preceding funicular segments combined.

Mesoscutum, axillae, and scutellum finely granulosely punctate, mat; propodeum in front of spiracle weakly reticulated, elsewhere smooth; pleura weakly reticulated, slightly shining. Forewing with nearly uniform, rather dense discal ciliation; speculum closed at posterior margin of wing but otherwise uninterrupted; marginal vein punctiform; postmarginal vein shorter than stigmal.

Abdomen short-ovate in outline, about as long as thorax or slightly longer, slightly narrower than thorax; weakly reticulately sculptured

and more or less distinctly shining dorsally and with similar sculpture ventrally. Ovipositor exerted one-fourth to one-third the length of abdomen.

*Male*.—Length 0.8 mm. Similar to female except as follows: Funicular segments subequal in length, but successively increasing in width from first to last, the fifth about as broad as pedicel and a little broader than long; club nearly as long as funicle; abdomen shorter than thorax, nearly circular in outline, blackish dorsally and ventrally with yellowish lateral margins above and beneath except at cerci, where the black on dorsum extends to the margins.

*Type locality*.—Winchester, Va.

*Type*.—U. S. N. M. No. 57324.

*Remarks*.—Described from numerous specimens received from D. W. Clancy of the Charlottesville, Va., laboratory of the Bureau of Entomology and Plant Quarantine and said to have been reared from *Pseudococcus virgatus* (Cockerell) collected at Winchester, Va., June 20, 1944, and recorded under laboratory note Nos. 676, 677, 678, and 681. Other specimens identified as this species were reared from the same host collected at Winchester, May 31, 1944, under laboratory No. 638; August 4, 1943, laboratory No. 529; August 3, 1944, laboratory No. 850; and at Hamilton, Va., August 12, 1943, laboratory No. 530, and May 30, 1944, laboratory Nos. 634 and 635.

## 2. PSEUDAPHYCUS PROSOPIDIS Timberlake

*Pseudaphycus prosopidis* TIMBERLAKE, Proc. U. S. Nat. Mus., vol. 50, p. 571, 1916.

Described from Mesilla, N. Mex., as a parasite of *Pseudococcus prosopidis* (Cockerell).

## 3. PSEUDAPHYCUS GRAMINICOLA Timberlake

*Pseudaphycus graminicola* TIMBERLAKE, Proc. U. S. Nat. Mus., vol. 50, p. 570, 1916.

Recorded by Timberlake as parasitizing pseudococcine scales on *Stipa* sp. at Las Vegas, N. Mex., and on *Elymus condensatus* at Kimballs, Utah. The host insect involved in the record from *Stipa* sp. has recently been identified by Morrison as *Trionymus neomexicanus* var. *utahensis* (Cockerell). The host on *Elymus* remains unidentified.

## 4. PSEUDAPHYCUS UTILIS Timberlake

*Pseudaphycus utilis* TIMBERLAKE, Proc. Hawaiian Ent. Soc., vol. 5, p. 323, figs. 1-4, 1923.—SWEZEY, Proc. Hawaiian Ent. Soc., vol. 5, p. 301, 1923.—TIMBERLAKE, Proc. Hawaiian Ent. Soc., vol. 5, p. 431, 1923.—WILLIAMS, Handbook of insects and other invertebrates of Hawaiian sugar cane fields, p. 255, 1931.—SWEZEY, Proc. 5th Pacific Sci. Congr. (Canada, 1933), vol. 5, p. 3532, 1934.—PEMBERTON, Hawaiian Planters Rec., vol. 45, p. 109, 1941.—ANON., Puerto Rico Exp. Stat. Rept. for 1940, p. 68, 1942.

This species is a parasite of *Pseudococcus nipae* (Maskell) and was originally described from the state of Veracruz, Mexico. It was intro-



duced into Hawaii in 1922 where, according to Pemberton, it proved so efficient as practically to exterminate its host. More recently it was introduced into Puerto Rico where, according to the above-cited report of the Puerto Rican Experiment Station, it gives every indication of bringing the host insect under complete control.

#### 5. PSEUDAPHYCUS WEBSTERI Timberlake

*Pseudaphycus websteri* TIMBERLAKE, Proc. U. S. Nat. Mus., vol. 5, p. 570, 1916.

Known only from the type, a single female, said to have been reared from the stems of *Elymus virginicus*, at Villa Ridge, Ill. The real host was probably a pseudococcine scale on the *Elymus*, as Timberlake pointed out.

#### 6. PSEUDAPHYCUS MACULIPENNIS Mercet

*Pseudaphycus maculipennis* MERCET, Bol. Real Soc. Espan. Hist. Nat., vol. 23, p. 140, fig. 2, 1923; Rev. Espan. Ent., vol. 1, p. 12, fig. 1, 1925.

Originally described from material collected on the island of Tenerife, Canary Islands. Mercet later collected it at Barcelona, Spain. No host has as yet been recorded for the species.

#### 7. PSEUDAPHYCUS ANGELICUS (Howard)

*Aphycus angelicus* HOWARD, Proc. U. S. Nat. Mus., vol. 21, pp. 241, 245, 1898.

*Pseudaphycus angelicus* (Howard) TIMBERLAKE, Proc. U. S. Nat. Mus., vol. 50, p. 573, 1916.—CLAUSEN, Univ. California Techn. Bull., Entom., vol. 3, pp. 258, 280, 1916.—FLANDERS, Jour. Econ. Ent., vol. 28, p. 552, 1935; vol. 33, p. 758, 1940.

*P. angelicus* was originally described from Los Angeles, Calif., as a parasite of *Pseudococcus* sp. on passionflower. It has since been recorded by Timberlake as parasitizing *Pseudococcus* (*longispinus* Targioni)=*adonidum* (Linnaeus), *ryani* (Coquillett), and (*citrophilus* Clausen)=*gahani* Green; by Clausen from *Pseudococcus maritimus* (Ehrhorn) and *gahani* Green; and by Flanders from *Pseudococcus adonidum* (Linnaeus) and *Phenacoccus gossypii* Townsend and Cockerell. All these records are of occurrences of the species in California, and thus far it is not known to occur outside of that State.

Timberlake has given a satisfactory description of this species in the paper cited above, except that it should be noted that the transverse fuscous band on the cheeks which he mentions is not always present.

#### 8. PSEUDAPHYCUS ABSTRUSUS, new species

The specimens to which this name is here assigned have proved exceedingly puzzling (hence the specific name).

*Female*.—Length 0.94 mm. Apparently agreeing in every respect with females of *angelicus* except that the frontovertex is very slightly narrower than in that species, and the general color is somewhat

darker, dirty orange-yellow, with the anterior margin of mesoscutum as well as the axillary sutures blackish and the metanotum, propodeum, and entire dorsum of abdomen deeper black. The color of antennae, underparts of the head and thorax, tegulae, wings, and legs is as in *angelicus*.

*Male*.—Length 0.8 mm. The single male specimen available for study has the antennal pedicel, first funicular segment, and the entire club white, the remainder of antenna black. In *angelicus* the pedicel is brownish, the first two segments of the funicle white, and the club mostly white but with its base narrowly blackish. Otherwise I can see no differences.

In both *angelicus* and *abstrusus* the frontovertex is densely and very finely alveolately sculptured, the alveoli very minute and discernible as such only under high magnification. This sculpture is very similar to that found in *alveolatifrons*, new species, described beyond, but in that species the alveoli are coarser and more distinct, the frontovertex is broader and shorter, and the ocelli are arranged in an equilateral instead of a distinctly acute triangle.

*Type locality*.—Roseland, Va.

*Type*.—U.S.N.M. No. 57325.

*Remarks*.—The holotype female and one female paratype were collected by D. W. Clancy, August 1, 1941, at Roseland, Va., on the bark of an apple tree infested with mealybugs and bear laboratory No. 745. The male allotype and one female paratype are labeled as having been reared from *Pseudococcus comstocki* (Kuwana) collected October 18, 1944, by Clancy at Colesville, Va., and bear laboratory Nos. 855 and 856, respectively.

#### 9. PSEUDAPHYCUS AUSTRIACUS Mercet

*Pseudaphycus austriacus* MERCEY, Rev. Espan. Ent., vol. 1, p. 13, fig. 2, 1925.

The type locality is Weyer, Austria. No host is known.

#### 10. PSEUDAPHYCUS ORIENTALIS Ferriere

*Pseudaphycus orientalis* FERRIERE, Bull. Ent. Res., vol. 28, p. 315, fig. 1, 1937.—LE PELLEY, Trans. Roy. Ent. Soc. London, vol. 93, p. 82, 1943.

This species was originally described as a parasite of *Pseudococcus lilacinus* (Cockerell) collected at Los Baños, Luzon, Philippine Islands. Le Pelley gives an account of its habits and biology.

#### 11. PSEUDAPHYCUS MALINUS, new species

*Aphycus* sp. HAEUSSLER and CLANCY, Journ. Econ. Ent., vol. 37, p. 504, 1944.

The description of *orientalis* Ferriere fits this species in many particulars but differs in respect to the ocellar triangle and the speculum of the wing. In *orientalis* the ocellar triangle is said to be acute, "the hind ocelli half as far from each other as from the front ocellus," and the wing is said to have "the hairless streak interrupted below the

middle." In *malinus* the ocellar triangle is somewhat acute, but the posterior ocelli are only slightly closer to each other than to the front ocellus and the hairless streak is not interrupted. One inconspicuous but seemingly constant character distinguishing *malinus* from all other species examined is that the clypeus has a very narrow brownish or blackish anterior border which constitutes a nearly straight and continuous dark line between the bases of the mandibles.

*Female*.—Length 0.9 mm. Frontovortex, mesoscutum, axillae, and scutellum dirty orange-yellow; temples, cheeks, and face below frons whitish except for a very narrow brownish or blackish line along the oral margin between bases of mandibles; occiput above the neck more or less blackish; antennal scape, pedicel, and funicle dark brownish or fuscous, the last funicular segment usually mostly whitish; club white; apices of mandibles dark brown; eyes black; ocelli dark reddish; pronotum whitish above, its anterior face in large part blackish; anterior margin of mesoscutum along the suture narrowly blackish; scutellum frequently with indications of an obscure brownish transverse band before apex; tegulae pale basally, fuscous apically; all legs and underside of thorax whitish, the middle and hind tibiae sometimes each with two more or less distinct fuscous bands; propodeum and dorsum of abdomen dark brown, the latter with a narrow transverse band of blackish at about basal one-third; under side of abdomen blackish with broad whitish margins. Forewing subhyaline, with a faint fuscous cloud behind the stigmal vein but without a hyaline band.

Frontovortex about two and one-half times as long as broad, granulosely sculptured; inner orbits parallel; ocelli in a nearly equilateral triangle, the posterior ocelli slightly closer to each other than to the anterior ocellus; ocellocular line equal to about half the diameter of an ocellus; anterior ocellus situated distinctly above middle of frontovortex; eyes clothed with short hairs. Antennae strongly clavate; scape subcylindrical, approximately four times as long as thick; pedicel about one-third as long as scape and subequal to first four funicular segments combined; funicular segments all transverse and successively increasing in width from first to last, the fifth segment fully twice as wide as the first; club solid, distinctly wider than last funicular segment and approximately as long as pedicel and entire funicle combined.

Mesoscutum, axillae, and scutellum finely sculptured, mat, and clothed with short pale hairs; propodeum very faintly reticulated, shining; mesopleuron with very fine and weak reticulation. Forewing with short dense discal ciliation distad of speculum, the cilia basad of speculum longer and not quite so dense; speculum closed at posterior margin of wing by about three rows of hairs, otherwise not inter-

rupted; marginal vein punctiform; stigmal vein longer than marginal and postmarginal combined.

Abdomen about as long and as broad as thorax, short-ovate to nearly circular in outline, weakly reticulated and more or less shining dorsally and ventrally; ovipositor exerted approximately one-sixth to one-fifth the length of abdomen.

*Male*.—Length 0.75 mm. Like female in all respects except that frontovertex is only about twice as long as broad, anterior ocellus only slightly above middle of frontovertex, and abdomen a little shorter and narrower than thorax.

*Type locality*.—Winchester, Va.

*Type*.—U.S.N.M. No. 57326.

*Remarks*.—The holotype female, allotype, and a larger number of paratypes of both sexes were reared by D. W. Clancy from *Pseudococcus comstocki* (Kuwana) collected August 11, 1943, at Winchester, Va., and recorded under Charlottesville, Va., laboratory No. 557.

This species was introduced from Asia into Virginia and several other eastern States in 1941–42 by the Bureau of Entomology and Plant Quarantine to combat the Comstock mealybug. Numerous specimens of the species reared from *P. comstocki* collected by R. W. Burrell and C. P. Clausen in Japan and Chosen have been examined and compared with the types, but since none of this Asiatic material is in first-class condition the description has been drawn from specimens representing recoveries of the species in Virginia. Since its original introduction specimens have been distributed for colonization in other localities, and the National Collection now contains material representing recoveries at the following points: Batesville, Berryville, and Hamilton, Va.; Proctorville, Ohio; South River, Morganville, and Moorestown, N. J.; Branford, Guilford, and Meriden, Conn.; and Bridgeville, Del.

#### 12. PSEUDAPHYCUS ANGUSTIFRONS, new species

The unusually narrow frontovertex will distinguish this species from all others known to me.

*Female*.—Length 0.8 mm. Frontovertex light orange; occiput more or less blackish above the neck; eyes black; ocelli dark red; remainder of head whitish. Antennal scape and pedicel black or blackish, the scape usually pale at base and sometimes with the dorsal margin pale; first three segments of funicle more or less fuscous, fourth and fifth segments white; club white. Pronotum whitish dorsally and laterally but with anterior face mostly blackish; mesoscutum, axillae, and scutellum brownish orange, with the sutures darker; propodeum dark brown; pleura, sterna, and all legs whitish; abdomen dorsally dark brown with whitish margins, ventrally entirely white. Wings uniformly faintly fuscous; marginal vein dark fuscous, other veins paler.

Frontovortex unusually narrow, fully three times as long as broad, granulosely punctate; inner orbits parallel or very nearly so; ocellar triangle strongly acute, posterior ocelli separated by a distance equal to about one to one and one-half times the diameter of an ocellus, nearly twice as far from anterior ocellus as from each other, almost touching the eye margins and a little more than the diameter of an ocellus from the occipital margin; anterior ocellus situated a little above the middle of frontovortex; eyes large, with very short and inconspicuous pile. Antennae strongly clavate; scape distinctly a little expanded beneath, widest beyond middle, very slightly less than four times as long as broad; pedicel about one-third the length of scape and about equal to first four segments of funicle combined; funicular segments all wider than long, successively increasing in width from first to last, the first segment narrower than pedicel, the fifth segment the largest and about twice as broad as long; club solid, distinctly broader than last funicular segment, and approximately as long as pedicel and funicle combined.

Mesoscutum, scutellum, and axillae finely sculptured but not wholly mat, clothed with short whitish hairs; propodeum smooth and shining; mesopleuron weakly sculptured. Forewing with speculum closed at posterior margin of wing and also interrupted a little behind the middle; discal ciliation distad of speculum short and moderately dense, proximad of speculum a little coarser and not quite so dense; marginal vein punctiform, postmarginal a little longer than marginal, stigmal distinctly longer than marginal and postmarginal combined.

Abdomen as broad as thorax and usually a little longer than thorax, ovate, weakly sculptured dorsally, smooth and shining ventrally; ovipositor sheaths exerted about half the length of abdomen.

*Male*.—Length 0.7 mm. Closely resembling female but with frontovortex only slightly more than twice as long as broad; anterior ocellus located very nearly at middle of frontovortex; abdomen no longer than thorax and subcircular in outline.

In some specimens of both sexes the prescutum is narrowly bordered anteriorly with black and in some males the ocellar triangle is blackish.

*Type locality*.—Cuba.

*Type*.—U.S.N.M. No. 57327.

*Remarks*.—Described from 26 females and 4 males, all intercepted at quarantine, at three different ports of entry, on shipments of pineapples originating in Cuba and in each case infested with mealybugs (probably *Pseudococcus brevipes* Cockerell). In most instances the parasites were actually reared from the mealybugs. The holotype female and two female paratypes were reared at Detroit, Mich., April 18, 1932, by W. W. Wood, under Detroit No. 1094. The allotype and three female paratypes were reared April 28, 1936, at New York, and

bear New York No. 58589. Other paratypes were intercepted May 13, 1936, under New York No. 59153; December 28, 1932, under New Orleans No. 5953; June 3, 1934, under New Orleans No. 8715; April 20, 1936, under New Orleans No. 17320; May 22, 1934, under New Orleans No. 8488; and April 28, 1936, under New York No. 58577.

### 13. PSEUDAPHYCUS MUNDUS, new species

*Pseudococcobius terryi* (Fullaway) BYNUM (not *terryi* Fullaway), Journ. Econ. Ent., vol. 30, pp. 756-761, 1937.

*Pseudaphycus* sp. nov. WOLCOTT, Insectae Borinquenses, pp. 128, 529, 1936.

This species closely resembles *angelicus* (Howard) but may be distinguished from that species by the fact that the forewing is more weakly and more uniformly infuscated, without a transverse hyaline band, and the speculum is not interrupted. The female differs further from *angelicus* by having the antennal club black or blackish at base instead of entirely white. The male differs from the male of *angelicus* by having the entire funicle of the antenna nearly uniformly pale grayish instead of mostly black with the first two segments only pale.

*Female*.—Length 1.1 mm. Frontovortex, mesoscutum, axillae, and scutellum dilute orange with a slight dusky tinge; head except frontovortex, tegulae, pronotum, entire underside of thorax and all legs white or whitish; propodeum and dorsum of abdomen blackish, abdomen beneath whitish; ovipositor pale at base, black at apex; eyes brownish black, ocelli dark reddish; occiput imbricated above the neck more or less infuscated and suture between pronotum and mesoscutum often fuscous; antennal scape black with a white dorsal margin; pedicel, entire funicle, and usually the greater part of basal segment of club black; last two segments and apex of first segment of club pure white; wings uniformly faintly fuscous, almost hyaline. Hairs on mesonotum white.

Frontovortex two and one-half to three times as long as broad, granulosely punctate; inner orbits practically parallel; ocelli in a slightly acute triangle; anterior ocellus situated distinctly above the middle of frontovortex, lateral ocellus about its own diameter from eye margin; eyes clothed with short pile. Antenna strongly clavate; scape distinctly a little expanded beneath, about four times as long as broad; pedicel a little more than one-third as long as scape and nearly equal in length to four following segments of funicle; funicular segments all strongly transverse, subequal in length but successively increasing in width, the fifth segment approximately twice as wide as the first and three times as broad as long; club large, indistinctly 3-segmented, broader than last funicular segment, and as long as or a little longer than entire funicle.

Mesoscutum, axillae, and scutellum weakly sculptured, rather distinctly shining and sparsely hairy; propodeum smooth; mesopleuron

uniformly weakly reticulated. Forewing with discal cilia basad of speculum a little sparser and slightly longer than distad, the speculum closed at posterior margin of wing by several rows of hairs but otherwise uninterrupted; marginal vein a little longer than broad, post-marginal distinct, about as long as stigmal.

Abdomen as long as head and thorax combined, as broad as thorax at base and tapering to a point at apex, distinctly reticulately sculptured over the whole dorsal surface, nearly smooth ventrally. Ovipositor exerted one-third the length of abdomen.

*Male*.—Length 0.85 mm. Like female except as follows: Whole antenna much paler in color, the scape whitish with a longitudinal fuscous stripe, pedicel and funicle grayish white, and club white; abdomen not longer than thorax, broadly rounded at apex, nearly circular, blackish dorsally but with lateral margins broadly margined with whitish.

*Type locality*.—Houma, La.

*Type*.—U. S. N. M. No. 57328.

*Remarks*.—Described from numerous specimens received from D. W. Clancy of the Charlottesville, Va., laboratory of the Bureau of Entomology and Plant Quarantine, where they were reared from *Pseudococcus boninsis* (Kuwana) collected at Houma, La., in November 1943. Besides this type series the following identifications of this species have been made by me: One specimen labeled as having been reared February 10, 1916, from *Pseudococcus calceolariae* (Maskell) [=misidentification of *P. boninsis* (Kuwana)] collected at Audubon Park, New Orleans, La., by E. R. Barber; three specimens reared in 1943 from *Pseudococcus boninsis* (Kuwana), collected at Houma and Raceland, La., by E. K. Bynum; two specimens indicated as having been reared from *P. boninsis* at Cairo, Ga., in 1932, by E. K. Bynum; two specimens taken at quarantine at Brownsville, Tex., on cut flowers from Mexico; nine specimens reared from the pink mealybug of sugarcane (*Trionymus sacchari* Cockerell), December 28, 1932, at Río Piedras, Puerto Rico, by F. Sein, under P. R. Acc. No. 178-32. Also before me are specimens reared in breeding tests at the Charlottesville, Va., laboratory from the following hosts: *Phenacoccus gossypii* Townsend and Cockerell, *Pseudococcus comstocki* (Kuwana), and *P. adonidum* (Linnaeus).

This species has become confused in the literature with *Aphycus terryi* Fullaway (= *Pseudococcobius terryi* Fullaway). In the article by E. K. Bynum cited above, it is indicated that living material of *A. terryi* was received in 1932 by T. E. Holloway, of the Bureau of Entomology and Plant Quarantine laboratory in New Orleans, from the Hawaiian Sugar Planters' Experiment Station in Hawaii. The original stock was apparently increased by propagation in the labora-

tory, and during the same year releases are said to have been made on three sugarcane plantations in Louisiana; at Cairo, Ga.; at Belle Glade, Fla.; and a small shipment sent to G. N. Wolcott for release in Puerto Rico. Other releases of the parasite are said to have been made in 1933, 1934, and 1936 in several additional localities in the three states mentioned. According to Bynum the parasite was recovered in the field of introduction at Houma in 1932 and each year thereafter up to the time of publication. Recoveries were allegedly made at several other points of introduction including Cairo, Ga., and Belle Glade, Fla. At some points of introduction no recoveries were made. According to Wolcott attempts in Puerto Rico to recover *terryi* resulted only in the rearing from *Trionymus sacchari* of specimens which were identified by Muesebeck as a new species of the genus *Pseudaphycus*.

In 1943 I received from D. W. Clancy, of the Charlottesville, Va., laboratory, a series of specimens of a parasite reared from *Pseudococcus boninsis* that had been sent to him by J. W. Ingram, of the Bureau of Entomology and Plant Quarantine laboratory at Houma, La. These specimens had been reared from mealybugs collected in 1943 from fields in the vicinity of Houma and were supposed to be representatives of the introduced *Aphycus terryi*. They proved not to be *A. terryi*, however, but the above-described new species, *Pseudaphycus mundus*.

Following this discovery a request was made to the Houma laboratory for samples of the original shipment of parasites received from Hawaii for introduction into Louisiana. Such a sample was received and proved to be true *A. terryi*. Another lot labeled, "Cairo, Ga., 1932, ex *Pseudococcus boninsis* E. K. Bynum SC #333," and apparently constituting a part of the original release at that point, was also received. This sample proved to be not *terryi* but *Pseudaphycus mundus*. No representatives of the other releases were obtained, but specimens taken at Houma and Raceland, La., in 1943, supposedly representing recoveries of *terryi*, again turned out to be *P. mundus*. The specimens mentioned by Wolcott as having been taken in Puerto Rico and identified by Muesebeck as *Pseudaphycus* n. sp. were located in the National Museum collection and were also found to be the same as those from Louisiana and Georgia.

The above data show that the parasite received from Hawaii was certainly *Aphycus terryi* but that this species has not been recovered at any of those points of release from which material has been submitted for identification. All the alleged *terryi* reared from field collections at Houma that I have seen have been the new species *Pseudaphycus mundus*. Apparently also it was this species, not *terryi*, which was released at Cairo, Ga. Furthermore, it appears probable that this was



the species introduced into Puerto Rico and that this introduction was successful even though the species introduced was not the one intended.

*Pseudaphycus mundus* may be indigenous in Louisiana. As noted above it was reared at Audubon Park, New Orleans, as early as 1916, at least 16 years prior to the attempted introduction of *Aphycus terryi*. Circumstantial evidence would seem to indicate that in the attempt to increase the stock of the Hawaiian parasite in the laboratory, field-collected material of the host which had already been attacked by *P. mundus* was introduced into the cages and the two species thus became confused.

#### 14. *PSEUDAPHYCUS LIMATULUS*, new species

The dorsum of the thorax in this species is more weakly sculptured, more distinctly shining, and of a darker yellowish-gray color than in any of the other species. Most closely resembles *graminicola* but distinguishable by the above characters and its slightly narrower frontovertex.

*Female*.—Length 0.75 mm. Frontovertex light orange-yellow; occiput slightly fuscous; eyes black; ocelli reddish; remainder of head whitish. Antennal scape and pedicel pale yellowish gray; funicle black or blackish; club mostly white, more or less stained with blackish basally. Mesoscutum, scutellum, and axillae yellowish gray; pronotum whitish, with its anterior face stained with blackish on each side of neck; propodeum dark brown; pleura, sterna, and all legs whitish; tegula whitish, its apex stained with fuscous; abdomen dorsally mostly dark brown or blackish, ventrally varying from mostly blackish to mostly whitish with only the middle blackish. Wings nearly uniformly faintly fuscous with faint indication of a paler transverse band beyond apex of venation. Ovipositor mostly dark brown, paler at base.

Frontovertex about two and one-half times as long as broad, mat, the sculpture made up of extremely minute alveolate punctures; inner orbits parallel for most of their length but diverging rapidly just above the scrobe; ocellar triangle nearly equilateral, or slightly acute; posterior ocellus about half its own diameter from eye margin and about its own diameter from occipital margin; anterior ocellus distinctly above middle of frontovertex; eyes with very short, inconspicuous pile. Antennae clavate; scape not expanded beneath; pedicel approximately one-third as long as scape and about as long as following four segments combined; funicular segments all broader than long, successively increasing in width from first to last, the fifth segment about twice as broad as long; club solid, distinctly broader than last funicular segment and only slightly shorter than funicle and pedicel combined.

Mesoscutum, axillae, and scutellum nearly flat, weakly sculptured, distinctly shining, and clothed with short pale pubescence; propodeum smooth and shining; mesopleuron weakly sculptured. Speculum of forewing partially interrupted near middle and closed at posterior margin of wing by one or two rows of cilia; discal ciliation moderately dense, very slightly coarser basad of speculum than distad of it; marginal vein punctiform, postmarginal short, stigmal about twice as long as marginal and postmarginal combined.

Abdomen ovate, very slightly longer than thorax and slightly narrower than thorax; tergites with distinct, shallow, reticulate sculpture, somewhat shining; sternites practically smooth and shining; ovipositor sheaths exerted approximately one-fifth the length of abdomen.

*Male*.—Length 0.65 mm. Similar to female but with frontovortex only about twice as long as broad, mesoscutum along its anterior margin narrowly black, abdomen distinctly shorter and narrower than thorax and circular in outline.

*Type locality*.—Stevensville, Kent Island, Md.

*Type*.—U.S.N.M. No. 57329.

*Remarks*.—Described from 21 females (1 holotype) and 5 males (1 allotype) reared by H. S. McConnell, from *Phenacoccus* sp. found feeding on a species of *Andropogon* at Stevensville on Kent Island in Chesapeake Bay, August 3, 1942.

#### 15. PSEUDAPHYCUS MERACUS, new species

This species is very similar to *meritorius*, new species, described elsewhere in this paper, and the two species are found infesting apparently the same species of mealybug in some localities in Virginia. It differs from *meritorius*, however, by having the segments of the funicle shorter and more transverse, by having the club somewhat longer than the entire funicle, and by having the anterior ocellus situated distinctly above the middle of frontovortex.

*Female*.—Length 0.86 mm. Frontovortex, mesoscutum, axillae, and scutellum orange with no dark markings; head except frontovortex, tegulae, pronotum, pleura, sterni, and all legs whitish; metanotum and propodeum orange, a shade lighter than scutellum; abdomen dorsally mostly yellowish with a narrow blackish cross stripe connecting the cerci and basad of this stripe with one and apicad of it with two similar but less distinct fuscous stripes; abdomen beneath slightly paler; ovipositor pale at base, darker apically; eyes grayish black, ocelli dark red; antennal scape nearly uniformly pale yellowish, pedicel and funicle fuscous, the apical funicular segments usually paler than the basal ones; club white. Wings uniformly subhyaline; marginal and stigmal veins fuscous. Hairs on mesonotum whitish.

Frontovortex somewhat more than twice as long as broad, finely granulose but under high magnification with faint indications of

alveolate sculpturing; inner orbits parallel for most of their length; ocelli forming a slightly acute triangle; anterior ocellus about one and a half times the width of frontovertex above the edge of scrobal cavity; lateral ocellus less than its own diameter from eye margin and more than its diameter from occipital margin; eyes with distinct short pile. Antenna clavate; scape not expanded beneath, slightly broader at middle than at either end, four times as long as broad; pedicel about one-third as long as scape, very nearly as long as first four funicular segments combined; funicular segments all broader than long, successively increasing in thickness from first to last, the basal segments distinctly narrower than pedicel, last segment about as broad as pedicel; club large, broader than last funicular segment and a little longer than entire funicle.

Mesoscutum, axillae, and scutellum uniformly granulosely punctate, mat; propodeum smooth; mesopleuron distinctly finely reticulate-punctate, subopaque. Forewing with rather dense discal ciliation, the cilia basad of speculum a little coarser than those beyond; speculum closed posteriorly by one or two rows of hairs, otherwise uninterrupted; marginal vein punctiform; stigmal vein a little longer than postmarginal.

Abdomen short ovate, slightly narrower and a little shorter than thorax, very weakly reticulated and shining dorsally, and practically smooth ventrally. Ovipositor exerted about one-fourth the length of abdomen.

*Male*.—Length 0.75 mm. Similar in practically every respect to the female except that the abdomen is nearly circular in outline, obviously shorter and narrower than the thorax and blackish medially with the margins broadly yellowish.

*Type locality*.—Hamilton, Va.

*Type*.—U.S.N.M. No. 57330.

*Remarks*.—Holotype female, allotype, and 13 paratypes reared July 5, 1943, from *Pseudococcus virgatus* (Cockerell), collected at Hamilton, Va., and received from D. W. Clancy of the Charlottesville, Va., laboratory under No. 528; also 35 paratypes reared May 16, 1944, from the same host collected at Batesville, Va., under Clancy's No. 611. Many additional specimens reared by Clancy from *P. virgatus* collected at Hamilton, Batesville, Crozet, Winchester, Greenwood, and Covesville, Va., are in the collection identified as this species but not considered a part of the type series.

16. *PSEUDAPHYCUS ALVEOLATIFRONS*, new species

Differs from all other forms studied in the coarser and much more distinct alveolate sculpture and paler orange-yellow color of the frontovertex.

*Female*.—Length 0.82 mm. Frontovortex very dilute orange yellow, its entire surface uniformly densely covered with fine but perfectly distinct facetlike punctures. In all other respects apparently agreeing with the foregoing description of *meracus* so that the description of that species except for the frontovortex will serve for this species also.

*Male*.—The head is gone from the single male specimen received so that the characters of the head are unknown. With respect to the other characters this male seems to differ in no significant respect from the male of *meracus*.

*Type locality*.—North Bergen, N. J.

*Type*.—U.S.N.M. No. 57331.

*Remarks*.—Described from a unique female and one headless male reared in November 1938 by George Rau from *Pseudococcus comstocki* (Kuwana).

The frontovortex in most of the forms studied is granulosely sculptured and mat, with little or no indication of distinct separate alveoli or punctures even under the higher magnifications of a binocular microscope. In *angelicus*, *abstrusus*, *meracus*, and *limatulus* the sculpture of frontovortex is more or less distinctly alveolate but the alveoli are finer and less definite. *P. alveolatifrons* differs from *angelicus* and *abstrusus* further by having the ocelli in an equilateral, instead of a distinctly acute, triangle and by lacking the transverse hyaline streak on the wing. From *limatulus* it may be distinguished by the distinctly duller sculpturing of the mesonotum as well as by its brighter orange-yellow color.

It is possible that additional material may show that the differences between *meracus* and *alveolatifrons* are not of specific value, but in view of the fact that the types of the two species are from different hosts and from different localities and this sculptural difference does exist, it seems wisest to give a separate name to this form from *P. comstocki* even though it may eventually turn out to be a synonym.





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## NEW CERAMBYCID BEETLES BELONGING TO THE TRIBE DISTENIINI FROM CENTRAL AND SOUTH AMERICA

By W. S. FISHER

DURING the process of rearranging the American species of the tribe Disteniini (Coleoptera: Cerambycidae) in the United States National Museum, four new species were found. These are described herein.

### Genus *DISTENIA* Lepelitier and Serville

#### *DISTENIA LATERALIS*, new species

Head, pronotum, and underside of body reddish brown; elytra and scutellum yellowish brown, the elytra with a distinct, broad, longitudinal, green vitta on each side near lateral margin; antennae brownish black; palpi and legs pale brownish yellow.

Head glabrous, sparsely, irregularly punctate. Antenna nearly one and one-half times as long as body, sparsely clothed with long flying hairs on underside; first segment slightly shorter than third, slender, cylindrical, gradually expanded toward apex, not depressed on top at base, rather densely, finely punctate, and sparsely clothed with long and short, semierect hairs.

Pronotum, not including lateral spines, slightly longer than wide, widest at middle; sides strongly constricted near base and apex, triangularly expanded on each side at middle and armed with a long, conical, acute spine; disk broadly, transversely depressed near anterior margin, transversely, sinuately grooved near base, with a slightly elevated space on each side in front of transverse, basal groove; surface glabrous, coarsely, sparsely, irregularly punctate, with a smooth, elongated, median space.

Elytra at base slightly wider than pronotum including lateral spines; sides gradually converging from bases to apices, which are

unispinose, the lateral spine on each rather short and acute, and the sutural angle feebly produced; surface very densely, coarsely, deeply punctate, becoming nearly impunctate near apices, very sparsely clothed with rather short, inconspicuous, erect, yellowish hairs.

Body beneath indistinctly punctate, very sparsely, irregularly clothed with short, inconspicuous, recumbent, yellowish hairs, with a few longer, erect hairs intermixed; femora slender, cylindrical, slightly clavate, each armed with a long, acute spine at apex.

Length 22 mm., width at base of elytra 4.5 mm.

*Type locality*.—Rurrenabaque (Beni River), Bolivia.

*Type*.—U.S.N.M. No. 57612.

*Remarks*.—Described from a single specimen collected at the type locality during October by William M. Mann in connection with the Mulford Biological Exploration during 1921–1922.

This species is closely allied to *Distenia limbata* Bates, but it differs from that species in having the head and pronotum reddish brown with only a vague bronzy reflection, the lateral spines on each side of the pronotum long and acute, the scutellum yellowish brown, the elytra more coarsely and densely punctured and with the apices armed with a long, acute, lateral spine, and the antennae brownish black.

**DISTENIA SPINIPENNIS, new species**

Head, pronotum, scutellum, elytra, and underside of body greenish black (elytra slightly more greenish); antenna (except first segment which is black) and palpi reddish brown; legs pale brownish yellow, the femora slightly darker at apices.

Head nearly glabrous, sparsely, irregularly, indistinctly punctate. Antenna one and one-half times as long as body; first segment distinctly shorter than third, robust, very strongly clavate, strongly, longitudinally depressed on top on basal half, scabrous and coarsely punctate basally, and sparsely clothed with long, fine, semierect hairs.

Pronotum, not including lateral spines, slightly longer than wide, widest at middle; sides strongly constricted near base and apex, triangularly expanded on each side at middle and armed with a rather long, acute spine; disk broadly, transversely depressed near anterior margin, narrowly, transversely, sinuately grooved near base, narrowly, transversely grooved along base, and with three slightly elevated, elongate, smooth spaces, one median and one on each side of middle; surface sparsely, indistinctly punctate in depressions, and clothed with a few short, indistinct, erect hairs.

Elytra at base as wide as pronotum including lateral spines; sides strongly converging from bases to apices, which are unispinose, the lateral spine on each long and acute, and the sutural angle rectangular; surface coarsely, densely, deeply punctate, becoming nearly im-

punctate at apices, rather densely, uniformly clothed with short, erect, whitish hairs.

Body beneath indistinctly, irregularly punctate, sparsely clothed toward sides with long and short, semierect, whitish hairs; femora slender, slightly clavate, unarmed at apices.

Length 19.5 mm., width at base of elytra 4 mm.

*Type locality*.—"Guapiles," 250-300 meters, Costa Rica.

*Type*.—U.S.N.M. No. 57613.

*Remarks*.—Described from a single specimen collected at light during May 1934, by Ferdinand Nevermann. The specimen is labeled Guapiles, which is probably an error for Guaplies.

This species is closely allied to *Distenia phaeocera* Bates, but it differs from the description given for that species in not having the elytra stria-punctate or the surface alutaceous, and in the slightly elevated smooth spaces on each side of the pronotum being not divided.

#### Genus COMETES Lepelitier and Serville

##### COMETES EMARGINATA, new species

Elongate and strongly shining, black, except anterior coxae, anterior femora (except tips), basal halves of middle and posterior femora, and tibiae in part brownish yellow.

Head finely, irregularly punctate on top, somewhat transversely rugose anteriorly, with a smooth, longitudinal groove extending from clypeus to occiput, sparsely clothed with long, erect and recumbent, whitish hairs. Antenna one and one-half times as long as body, sparsely clothed with long, flying hairs on underside; first segment slightly longer than third, robust, cylindrical, gradually expanded toward apex, finely, rugosely punctate, sparsely clothed with long erect and short recumbent, whitish hairs.

Pronotum as wide as long, widest at middle; sides strongly constricted near base and apex, triangularly expanded on each side at middle but not distinctly spinose; disk broadly, transversely depressed near anterior margin, transversely, sinuately grooved near base, narrowly, transversely grooved along base, and with two slightly elevated, round, smooth gibbosities on each side of middle; surface densely, finely punctate in median depression, the punctures nearly concealed by a dense, recumbent, yellowish pubescence, and with a few long, erect, white hairs.

Elytra at base as wide as pronotum at middle; sides gradually converging from bases to apices, which are separately emarginate, the lateral spine slightly longer than sutural spine; surface coarsely, deeply, densely punctate, the puncture forming more or less distinct rows but becoming obsolete toward apices, rather densely clothed toward sides with short, indistinct, recumbent, whitish hairs, with a



few long, erect hairs intermixed, and each elytron ornamented with a narrow vitta of transversely recumbent, white hairs along sutural margin.

Body beneath indistinctly punctate, sparsely clothed at sides with short, recumbent, whitish hairs; legs sparsely clothed with long and short, semierect, white hairs.

Length 11 mm., width 2 mm.

*Type locality*.—Hamburg Farm (on Reventazon River), Costa Rica.

*Type*.—U.S.N.M. No. 57614.

*Remarks*.—Described from a single specimen collected at the type locality on grass, May 26, 1934, by Ferdinand Nevermann.

This species can be separated from the other described species of this genus by having the tips of the elytra emarginate.

COMETES BICOLOR, new species

Elongate, rather strongly shining except elytra which are sub-opaque; antennae bluish black with a vague violaceous reflection; head, pronotum, scutellum, underside of body, and legs bluish black with a distinct greenish or violaceous tinge; elytra brownish yellow with apical fourth and elevated lateral margins violaceous blue.

Head rather coarsely, irregularly punctate on top, somewhat transversely rugose anteriorly, with a smooth, longitudinal groove extending from clypeus to occiput, very sparsely clothed with inconspicuous, semierect hairs. Antenna nearly one and one-half times as long as body, sparsely clothed on underside with long, flying hairs; first segment as long as third, slender, cylindrical, narrow at base, strongly expanded toward apex, rather densely, coarsely, shallowly punctate, sparsely, uniformly clothed with short, semierect, whitish hairs.

Pronotum slightly wider than long, widest at middle; sides strongly constricted near base and apex, obtusely expanded on each side at middle but not spinose; disk broadly, transversely depressed near anterior margin, shallowly, transversely, sinuately grooved near base, narrowly, transversely grooved along base, with two irregular, smooth elevations on each side of middle, and an elongate, smooth, median elevation; surface coarsely, deeply, confluent punctate, sparsely clothed with moderately long, erect, inconspicuous hairs.

Elytra at base as wide as pronotum at middle; sides parallel from bases to near apices, which are separately narrowly rounded; surface densely, coarsely, deeply, uniformly punctate, the punctures becoming more confluent toward apices, rather densely clothed with short, inconspicuous, erect hairs, and each elytron with two more or less distinct longitudinal costae, the inner costa extending from base to middle of elytron, and outer one from base to apical fourth.

Body beneath sparsely, shallowly, irregularly punctate, sparsely, irregularly clothed with moderately long, semierect, fine hairs; legs rather densely clothed with long and short, semierect, whitish hairs.

Length 11.5 mm., width 3 mm.

*Type locality*.—Colombia, South America (no definite locality).

*Type*.—U.S.N.M. No. 57615.

*Remarks*.—Described from a single specimen collected August 31, 1942, by Francisco J. Otoyá (No. 2053).

This species is allied to *Cometes pulcherrimus* Bates, but it differs from that species in having the pronotum more densely and coarsely punctured, and the basal three-fourths of the elytra brownish yellow, with only the apical fourth and narrow lateral margin of each elytron violaceous blue. The head is mounted separately on the same pin with the rest of the specimen.





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## MACHAEROIDES EOTHEN MATTHEW, THE SABER-TOOTH CREODONT OF THE BRIDGER EOCENE

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THE 1940 Smithsonian Institution expedition to the Bridger Basin of Wyoming had unusual good fortune in securing skeletal remains of the rare creodont *Machaeroides eother*. The materials, consisting of skull, lower jaws, and other skeletal portions of one individual, were found by Franklin Pearce in low exposures, probably of Bridger "C," immediately to the north of Twin Buttes, about 30 miles southwest of Green River, Wyo. Previous finds of this remarkable sabertooth form, so far as known, are limited to the lower jaw portions described by Matthew<sup>1</sup> in 1909.

The skull, U.S.N.M. No. 17059, was found with the lower jaws in a position of articulation, and although essentially complete there has been a small amount of transverse crushing and distortion so that the right side of the skull is higher than the left. The remainder of the skeleton includes portions of the vertebral column, both humeri and femora, the right radius and ulna, an incomplete left tibia, and fragments of the pectoral and pelvic girdles. The feet were not present except for a carpal and two metacarpal bones.

Matthew readily appreciated the indications in the lower jaw portions of *Machaeroides eother* of a modification nearly paralleling that of the machairodont forms among the Fissipedia. In the materials he had at hand these modifications were not too evident, and R. H. Denison<sup>2</sup> was inclined to consider the *M. eother* jaw as resembling *Felis* and not truly "sabertooth." The

<sup>1</sup> Matthew, W. D., Mem. Amer. Mus. Nat. Hist., vol. 9, pt. 6, pp. 462-463, 1909.

<sup>2</sup> Denison, R. H., Ann. New York Acad. Sci., vol. 37, p. 181, 1938.

National Museum specimen, however, leaves no doubt of the direction and extent of specialization, which quite parallels that seen in the machairodonts but not to the extent exhibited in the Uinta *Apataelurus kayi* described by Scott.<sup>3</sup> Structurally no characters are observed in the illustrations of the lower jaws of *A. kayi* that would preclude derivation of this form from *M. eothen*, with the characteristics attendant upon sabertooth development reaching a high degree of specialization within an interval of time suggesting a comparatively rapid evolutionary tempo.

Matthew regarded *Machaeroides eothen* as an oxyaenid type of creodont, closely related to forms included in the subfamily Limnocyoninae, to which he allocated it (p. 410),<sup>4</sup> having created, however, the subfamily name "Machairoidinae" on an earlier page (330). Denison<sup>5</sup> retained the supergeneric separation, which was entirely justified by the discovery of *Apataelurus*, recognizing a natural phyletic subfamily. However, Denison removed the Limnocyoninae and Machaeroidinae from the Oxyaenidae and placed them in the Hyaenodontidae. Justification for this was claimed on the basis of morphological differences between the Oxyaeninae and Limnocyoninae and similarities between the Limnocyoninae and Proviverrinae, particularly between *Prolimnocyon* and *Sinopa*. Separation from the Oxyaenidae seems supported, and, moreover, carnassial specialization, which has been the key to their supposed affinity, may well have developed independently in the two groups. I cannot, however, but regard the carnassial differentiation that so readily distinguishes the Limnocyoninae from members of the Hyaenodontidae as being of fundamental importance, and hold that the morphological similarities may be as easily attributed to similar adaptation or parallelism. It is in a similar manner that the Machaeroidinae so markedly resemble the machairodonts, although obviously not derived one from the other. Derivation of the Limnocyoninae from an early proviverrine stock is not disproved and may be reasonable as suggested by the similarity of lower jaws belonging to forms of *Prolimnocyon* and *Sinopa mordax*, but their divergence must originate in a primitive form with molars as yet undifferentiated as to carnassials, and where *M.*<sup>1</sup>, for example, has not taken on characteristics so markedly different in the two groups.

<sup>3</sup> Scott, W. B., Ann. Carnegie Mus., vol. 27, art. 6, pp. 113-120, 1938.

<sup>4</sup> Matthew, W. D., *ibid.*

<sup>5</sup> Denison, R. H., *ibid.*, p. 181.

Inasmuch as it seems advisable to exclude the Limnocyoninae from the Oxyaenidae, and since I am unable to reconcile it with the Hyaenodontidae on the basis of carnassial differentiation, I propose, at the risk of censure, that the Limnocyoninae and Machaeroidinae be given family recognition as the Limnocyonidae.

*Description of skull* (pl. 45).—The skull of *Machaeroides eothern* is significantly smaller than that of *Limnocyon verus* but much larger than *Thinocyon velox*, corresponding closely in size to *Sinopa rapax* among its less closely related contemporaries. The skull is moderately slender but with a noticeably deep rostrum, high sagittal crest, and a narrow occiput.

The rostrum, in addition to depth, exhibits a well-inflated maxillary portion covering the long root section of the canine, extending parallel and immediately posterior to the suture joining the premaxilla. The nasals extend posteriorly in a nearly V-shaped wedge between the frontals, terminating fully as far back as the postorbital processes. In *Thinocyon* and *Limnocyon* the nasals as exposed terminate distinctly forward of this position. The postorbital processes of the frontals are moderately well developed and, although possibly not complete, do not appear so prolonged as in *Thinocyon*. The lachrymal bone in *M. eothern* is large and extends well forward of the orbit and exhibits a most unusual feature in that the lachrymal foramen enters the skull anterior to the orbital rim and anteroventral to the lachrymal crest or tubercle. A smaller foramen also enters the lachrymal bone outside and immediately dorsal to the lachrymal tubercle. This arrangement was not observed in other creodonts, but it occurs in marsupials and sloths. Matthew,<sup>6</sup> however, noted that the lachrymal foramen in *Limnocyon* was very near the orbital rim.

The cranial portion of the skull is characterized by an exceedingly small brain case, relatively much smaller than in *Thinocyon*, and a very high sagittal crest, which joins a high but narrow occipital crest. The latter is overhanging but, quite unlike *Limnocyon*, is noticeably constricted transversely immediately above the occipital condyles. A prominent vascular foramen is noted at the suture between the parietal and squamosal at a position about over the trough for the audital tube, and one also in the posterior portion of the temporal fossa, presumably at about the juncture of the parieto-squamosal and parieto-occipital sutures.

In ventral aspect the palatal portion of the skull shows no unusual features. No evidence exists of the grooves and ridges

<sup>6</sup> Matthew, W. D., *ibid.*, p. 438.

characterizing the later fissiped sabertooth cats. However, palatal excavations between the deutocone or protocone portions of successive 3-rooted teeth, for reception of the much-elevated protoconids of the lower cheek teeth, are as well developed as in several of the other creodonts. The posterior margin of the palate is extended posteriorly a very short distance below the narial passage, somewhat as in *Limnocyon*. The palatal margin outside the narial passage, however, shows a conspicuous notch for the palatine vein, with well-developed tuberosities on both the palatal and maxillary sides of the groove.

The zygomatic arch arises from perhaps a slightly higher position on the relatively deep rostrum of *Machaeroides eotheri* than it does in *Limnocyon verus*, although in *M. eotheri* the left arch is broken down to a position below normal on that side of the skull. The depth of the arch is moderate, but because of crushing the extent to which it is expanded laterally cannot be determined. Posteriorly the arch terminates at a position relatively low with respect to the basicranial surface. The zygomatic process of the squamosal projects conspicuously downward from the basicranium, placing the glenoid surface for articulation of the lower jaw at a much lower level than observed in other creodonts, a condition noted in machairodonts and in the sabertooth marsupial *Thylacoscylus atror*. This lowering of the fulcrum gives leverage to the temporal muscle acting on a coronoid process of reduced height. The reduction of the coronoid presumably permitted the lower jaw to open wide enough for the mandible to clear the sabertooths, apparently much wider than necessary in other carnivores, except *Apataelurus* and the machairodonts.

The basicranial portion of the skull is the least distorted by crushing and is relatively elongate and clearly much narrower than in *Limnocyon verus*. The paroccipital process shows very little development and does not project posteriorly as in *Limnocyon verus*. However, in addition to the downward-projecting pedestallike base for the glenoid surface, the mastoid process, as in the machairodonts, is very well developed, projecting downward and forward, and noticeably expanded in an anterointernal-posteroexternal direction. The mastoid process is moderately developed in most creodonts including *Limnocyon*, but nowhere in the suborder is it relatively so important, particularly in a forward medial extension, as in *M. eotheri*, and in *Apataelurus* by inference. Its prominence and rugosity demonstrate the strength and importance of the sterno-cleido-mastoid muscle, the actions of which include depressing the head, as in striking with the

sabers. The mastoid process is essentially a part of the mastoid portion of the periotic; however, the extent to which the squamosal enters into its composition cannot be determined, limited possibly to a portion of the anterior surface of the process.

The foramina of the basicranium show certain significant differences in relative position from those in *Limnocyon verus* or in *Thinocyon velox*. For the most part these maintain a primitive, creodont arrangement with differences noted in *Machaeroides eothen* that are in part due to structural modification attendant upon sabertooth development. The alisphenoid canal, if present, is decidedly long as in *Limnocyon*, but with the posterior opening confluent with or not distinguished from the foramen ovale, so that it was not certainly identified in the material at hand. In *Limnocyon verus* the posterior opening of the alisphenoid canal is shown by Matthew<sup>7</sup> as well forward of the foramen ovale. The foramen ovale in *M. eothen* is located medial to the postglenoid process, at the root of the pterygoid wing of the alisphenoid. The postglenoid foramen enters the skull at the base of the posterior surface of the postglenoid process but exhibits a groove for about half the length of this surface before closure is complete. The foramen lacerum medius is in a customary position antero-internal to the exposed portion of the petrosal. From a position medial to the promontorium of the petrosal a narrow cleft extends posteriorly along the outwardly convex lateral margin of the basioccipital to the foramen lacerum posterius, about halfway to the occipital condyles. The internal carotid evidently entered the brain case at some point along the anterior part of the cleft and adjacent to the petrosal. The condylar or hypoglossal foramen is well forward of the condyles and separated by a thin partition from the foramen lacerum posterius, quite unlike *Limnocyon* or *Thinocyon* but resembling certain specimens of the Oligocene *Daphoenus* in this respect. The stylomastoid foramen shows as a groove on the medial margin of the mastoid process. Dorsally this is completely enclosed, presumably by bone belonging to the mastoid portion of the periotic, at the root of the mastoid process, posterolateral and very close to the promontorium of the petrous portion.

*Machaeroides eothen* is without a tympanic bulla, and the tympanic ring was not preserved. The site of the audital tube is a deep and compressed U-shaped trough between the postglenoid and mastoid processes, extending laterally and somewhat posteriorly from below the anteroexternal portion of the

<sup>7</sup> Matthew, W. D., *ibid.*, fig. 55.



petrosal. In *Limnocyon* and *Thinocyon* the trough is more widely open and relatively shorter. The petrosal is partially exposed on both sides of the skull of *M. eothen*. It exhibits an acutely projecting promontorium located immediately inward from the medial margin of the mastoid process. The petrosal is more broadly rounded ventrally in *Thinocyon*. The fenestra rotunda in *M. eothen* is large and faces posteriorly and slightly outward and downward below the flattened ventral surface of the posterior portion of the petrosal. The anterior surface of the petrosal is broad and flattened, facing anterolaterally and ventrally and joining the medial surface in a bluntly rounded angle that extends anteromedially and dorsally from the promontorium. The fenestra ovale faces slightly forward of lateral and is situated very deep in the mesotympanic fossa, almost directly above but well separated from the promontorium. It is much higher in position than the fenestra rotunda and is very much above the lip of the trough for the audital tube. Further description of the petrosal and its relation to the cranial cavity is not undertaken, inasmuch as such additional information cannot be obtained without damage to the skull.

*Upper dentition.*—The dental formula for the upper teeth of *Machaeroides eothen* is 3-1-4-2, as noted by Matthew in *Limnocyon* and as observed in *Thinocyon*. Moreover, the first upper molar is the carnassial as in these forms and as in the Oxyaenidae. The teeth resemble those in the Limnocyoninae with certain exceptional characteristics which for the most part are modifications seemingly accompanying sabertooth development.

The incisors are slender, recurved, conical teeth adapted for piercing and with transversely flattened roots. Unlike *Limnocyon* they increase in size from first to third,  $I^3$  being much more robust and with a root portion about twice as long as in  $I^1$ .  $I^3$  in *Limnocyon* is much smaller than  $I^2$  and may not be present in some individuals, as indicated by Matthew.<sup>8</sup> In *Thinocyon* the three are subequal and slightly spatulate.

The enlarged canine is preserved only on the left side and is broken away a short distance below the alveolus. It is removed from  $I^3$  by a short diastema. The tooth as exposed has no cingulum, is nearly oval in cross section, and has a long gently curved root section, as inferred from the inflated portion of the maxilla. In Matthew's<sup>9</sup> illustration of *Limnocyon* versus the upper canine appears to have an exposed cingulum and the short crown is

<sup>8</sup> Matthew, W. D., *ibid.*, p. 434.

<sup>9</sup> Matthew, W. D., *ibid.*, fig. 53.

noticeably recurved below this point. The length of the canine in *M. eother* cannot be determined from the present material; however, if this tooth extended as far as the flange of the lower jaw it would have had a length of about 3 cm. beyond the alveolus. The canine shows no evidence of serrations along the anterior or posterior margins.

The premolars of *M. eother* are 1-, 2-, 3-, and 3-rooted, respectively.  $P^1$ , preserved only on the right side when found but subsequently lost, is a small, simple, conical tooth without an accessory cuspule and separated by a diastema from both the canine and  $P^2$ . In both *Limnocyon* and *Thinocyon*  $P^1$  is 2-rooted and exhibits a small posterior cuspule.  $P^2$  of *M. eother*, in addition to being 2-rooted, retains a vestige of a posterior cuspule. The tooth is relatively much smaller and transversely more compressed than in *Limnocyon*.  $P^3$ , on the other hand, is much better developed than in *Thinocyon* and apparently than in *Limnocyon*. This tooth, preserved only on the left side, has a minute parastyle and a rather well developed posterior cusp or crest, approximating  $P^4$  in this respect. The lingual root is slender but extends markedly inward from about midway of the tooth length and supports a very small deuterocone.  $P^4$  is relatively robust with a prominent parastyle before and a trenchant cusp posterior to the large backward sloping primary cusp. The deuterocone portion is broad and well defined, extending lingually from the midportion of the tooth. The deuterocone portion does not project forward as it does in *Thinocyon* or (to a less degree) in *Limnocyon*. The deuterocone is situated on the lingual margin of the talon and is connected with the primary cusp by a low crest across the forward part of the talon. A small, shallow basin is enclosed between this forward crest and the low circular crest around the posterior margin of the talon.

The difference in development of the various premolars is rather striking in comparison with related forms.  $P^1$  and  $P^2$  are relatively small and less progressive, probably reduced from an earlier but more advanced state, paralleling the machairodonts in this respect, as an accompanying factor in sabertooth specialization.  $P^3$ , however, has retained a more advanced stage of development and undoubtedly continued to be a significant and functional tooth in the later and more advanced *Apataelurus*, as indicated by the well-developed and trenchant  $P_4$  with which it occludes in the lower jaw of the Uinta form.

$M^1$ , the upper sectional tooth in *Machaeroides eother*, has taken on a very trenchant appearance as compared either with the

preceding  $P^4$  of *Machaeroides* or with  $M^1$  in *Limnocyon* and *Thinocyon*. The talon portion is much reduced and far forward in position, the deuterococone being but a very small cusp at the anterolingual angle of the tooth. The posterior crest is elongate and the greater part of the lingual face of the tooth forms a flat shearing blade which, though oblique, is directed more nearly longitudinal than in either *Limnocyon* or *Thinocyon*. The paracone and metacone of  $M^1$  are closely connate, more so than in *Limnocyon*, approximately as in *Tritemnodon*. The parastyle is but weakly developed, being represented only by an enlargement of the cingulum anteroexternal to the paracone.

$M^2$  has a nearly transverse shear and is characterized in distinction from that in *Limnocyon* and *Thinocyon* in having lost all trace of the metacone. Also, the talon is reduced to a very subdued projection from the paracone, the shear being effected essentially by the paracone and parastyle, whereas in *Limnocyon* and *Thinocyon* the talon participates very largely in the shearing structure, cutting against the metaconid and occluding with the talonid of  $M_2$ . The reduction of the talon of  $M^2$  in *M. eothen* accompanies the loss of the metaconid and extreme reduction of the talonid of the lower carnassial.

*Mandible* (pl. 46, a, b).—The lower jaw of *Machaeroides eothen* has been briefly described and figured by both Matthew and Denison, and the relationship to other creodonts discussed at length. However, the specimens available to them for study were incomplete, lacking particularly the extremity of the flange, coronoid process, and the crowns of the canine and carnassial teeth. Restorations of these parts in drawings were conservative in indicating less modification from the limnocyonine pattern than the more complete material demonstrates.

The lower jaw is relatively very deep and transversely slender compared to jaws belonging to forms of the Limnocyoninae. Its flange projects downward to a greater extent than anticipated but not to the extent shown in *Apataclurus kayi*, and much less than in *Hoplophoneus*. In *M. eothen* it projects but a little below the dorsoventrally elongate symphysis and curves gently outward so that the width across the extremities of the flanges is greater than at any point above. The deep symphyseal surface has a nearly straight, steeply inclined anterior margin, which makes an abrupt angle with lower margin. The coronoid process of the lower jaw appears truncated and much reduced from the large and fully developed coronoid observed in *Limnocyon* and *Thinocyon*. The reduction, nevertheless, has not gone so far as that in *Apataclurus*.

Moreover, the condyle is lower with respect to the tooth row. The angle, less widely separated from the condyle, does not curve downward from the nearly straight lower margin of the jaw but preserves the alignment practically to its extremity, more so than in *Apataelurus*. The masseteric fossa is well defined with a sharp masseteric crest anterodorsally; however, the fossa, as in *Apataelurus* and also *Patriofelis*, extends farther forward beneath the carnassial than in *Limnocyon* and *Thinocyon*. The mental foramina are beneath  $P_1$  and the posterior root of  $P_2$  and placed relatively low on the side of the jaw.

*Lower dentition.*—The lower teeth are all present, although the right canine and  $P_2$  as well as the left carnassial and median incisors are slightly damaged. The lower incisors of *Machaeroides eohen* were most certainly reduced to two. The lateral of these is the larger of the two, and both, as in the case of the upper incisors, are piercing type structures with transversely flattened roots. In lateral view the canine appears moderately robust at the alveolar border but is transversely flattened and tapers rapidly to a point only a little above the closely adjacent incisors. Moreover, it shows a pronounced scar or bevel vertically along its posterolateral surface, worn through occlusion with the superior canines.

The cheek teeth appear decidedly slender, and the two anterior premolars, both of which, however, retain two roots, are of rather small size.  $P_3$  is about intermediate in size and development between  $P_2$  and  $P_4$ . It has a crested talonid, almost as in  $P_4$ ; a structure but very feebly expressed in  $P_2$ .  $P_3$  is without a paraconid, whereas in  $P_4$  this cusp is low but distinct. Both  $P_3$  and  $P_4$  are more progressive than in *Limnocyon* and *Thinocyon*; however, in *Apataelurus*  $P_3$  has become relatively much reduced in size.  $P_4$  in both *Machaeroides* and *Apataelurus* has become a relatively large and functionally significant tooth, actually exceeding  $M_1$  in size in both forms.

The two molars possess somewhat more distinctive structural characters than the premolars in characterizing *Machaeroides*. In  $M_1$  the metaconid is but moderately developed and pressed close to the protoconid. The talonid is much reduced in size and trenchant in character. In *Limnocyon* and *Thinocyon* the relatively wider and more robust  $M_1$  has a better-developed metaconid and a large, deeply basined talonid. In *Apataelurus* the trenchant heel persists and evidence remains of a metaconid that has not been entirely obliterated by the shearing function imposed on the tooth.

The carnassial,  $M_2$ , in *M. eother* exhibits more noticeable modifications than  $M_1$  toward a sabertooth specialization. The metaconid is lost, except for a slight rugosity on the posterointernal margin of the backward sweeping protocone. The talonid is reduced to little more than a vestige, although its expression is somewhat better in the specimen figured by Matthew.<sup>10</sup> The tooth is almost catlike in appearance, quite unlike that in *Limnocyon* or *Thinocyon* where the carnassial is very much like  $M_1$  except for its greater size and higher trigonid. In *Apataelurus* the lower carnassial has almost or quite reached the stage exhibited by *Smilodon* in its modification for shearing, but still preserving a vestige of its trenchant talonid.

TABLE 1.—Measurements (in millimeters) of skull, mandible, and dentition of *Machaeroides eother*, U. S. N. M. No. 17059

Greatest length of skull from anterior margin of premaxillae to posterior margin of occipital condyles.....	a 135
Distance from anterior margin of premaxillae to posterior narial aperture.....	a 65
Greatest depth of maxillae above $P^2$ .....	a 32
Width of palate between canine alveoli.....	a 16
Greatest width of basicranial region across mastoid processes.....	a 48
Length of upper dentition from $I$ to $M^2$ inclusive.....	a 62
Length of upper dentition from anterior margin of canine alveolus to $M^2$ inclusive.....	a 55
Width across $I^1$ to $I^3$ inclusive.....	75
Length of cheek tooth series, $P^1$ to $M^2$ inclusive.....	42
Length of diastema anterior to $P^1$ ; posterior to $P^1$ .....	3.5: 2.5
Length of premolar series, $P^1$ to $P^4$ inclusive.....	30
Length of molar series, $M^1$ to $M^2$ .....	11.3
Canine—anteroposterior diameter at alveolus: transverse diameter.....	8.5: 5
$P^1$ —anteroposterior diameter: greatest transverse diameter.....	3.2: 2.1
$P^2$ —anteroposterior diameter: greatest transverse diameter.....	5.4: 2
$P^3$ —anteroposterior diameter: greatest transverse diameter.....	8: 5
$P^4$ —anteroposterior diameter: greatest transverse diameter.....	10: 8.2
$M^1$ —anteroposterior diameter: greatest transverse diameter.....	9.4: 7.5
$M^2$ —anteroposterior diameter: greatest transverse diameter.....	3.5: 3.1
Length of lower jaw from anterior extremity to condyle.....	92
Depth of symphysis of lower jaw measured along anterior face.....	26
Depth of flange of lower jaw below diastema between canine and $P_1$ .....	22
Depth of lower jaw below $P_2$ .....	16.5
Depth of lower jaw below $M_2$ .....	16.5
Height of coronoid process above inferior margin of ramus.....	28
Length of lower dentition from anterior margin of canine to $M_2$ inclusive.....	87.5
Length of cheek tooth series, $P_1$ to $M_2$ inclusive.....	43.5
Length of diastema anterior to $P_1$ ; posterior to $P_1$ .....	3: 2
Length of premolar series, $P_1$ to $P_4$ inclusive.....	23.8
Length of molar series, $M_1$ and $M_2$ .....	15.9
Canine—anteroposterior diameter at cingulum: transverse diameter.....	6.7: 3.5
$P_1$ —anteroposterior diameter: greatest transverse diameter.....	3.6: 1.6
$P_2$ —anteroposterior diameter: greatest transverse diameter.....	4.7: 2
$P_3$ —anteroposterior diameter: greatest transverse diameter.....	7.6: 3
$P_4$ —anteroposterior diameter: greatest transverse diameter.....	9.1: 4
$M_1$ —anteroposterior diameter: greatest transverse diameter.....	3.6: 4
$M_2$ —anteroposterior diameter: greatest transverse diameter.....	3.7: 4.4

*Vertebrae*.—Among cervical vertebrae preserved of *Machae-*

<sup>10</sup> Matthew, W. D., *ibid.*, fig. 71.

*roides eothen* are the atlas, axis (badly crushed), and three others including the seventh. The transverse processes are not complete on the atlas, but sufficient remains to show that the groove or notch at the anterior extremity for the anterior course of the vertebral artery and the inferior branch of the spinal nerve is not covered but widely open as in *Thinocyon*. The posterior opening of the vertebrarterial foramen, however, is distinctly on the posterior border of the transverse process, not dorsal to it as described by Matthew for *Thinocyon*.

The two intermediate cervicals between the axis and the seventh show a well-developed inferior lamella with the forward ridge well separated from the forward extension of the transverse process by the opening of the vertebrarterial canal. These also show a well-developed forward projecting hyperapophysis beginning superior to the postzygapophysis and extending forward half to three-quarters of the way to articular surface of the anterior zygapophysis. It is lower than the spine and more compressed transversely.

The first eight dorsal vertebrae were found in articulation with the last cervical, and the centra of seven additional vertebrae, not in articulation, were preserved, at least four of which belong to the lumbar series. The anterior dorsals show elongate transverse processes for articulation with the ribs, and moderately high but rapidly tapering spines. The spine of the first dorsal appears to be the longest, and possibly the only one to have an anteroposteriorly expanded tip. The centra identified as lumbar are very elongate, dorsoventrally flattened, and with the articular faces markedly sloping, downward and backward with respect to the longitudinal axis.

*Limb bones* (pl. 46, c-f).—The humerus of *Machaeroides eothen* is distinctly larger and more robust than in *Limnocyon verus*. The deltoid and ectocondylar ridges are wide and flaring, and both extend for a greater proportion of the length of the shaft than in *L. verus*. The development of the deltoid crest together with the high and widely expanded acromion of the scapula furnishes good leverage and indicates the importance of the deltoid muscle, which functions in raising the arm outward. The prominence and length of the ectocondylar ridge denote good leverage for the supinator longus in flexing and supinating the forearm. The greater and lesser tuberosities are well developed with large rugose surfaces for the muscles used in rotating the humerus. The distal end of the humerus exhibits a large, oval entepicondylar foramen and well-developed condyles, particularly the inner, which has a very rugose

anterodistal surface for attachment of flexor muscles for the manus and forearm.

The radius and ulna are longer than in *Limnocyon verus* and noticeably curved. Both elements are noticeably flattened transversely and anteroposteriorly expanded in their distal portions, although a part of this is recognized as due to crushing. The olecranon of the ulna is relatively robust and bent somewhat inward but is not so long as in *L. verus*. The shaft of the ulna is not convex anteriorly, as described for *L. verus*, but, if anything, is concave anteriorly. The radius shows a compound curve, concave forward in the proximal portion and convex forward in the medial and distal portions. The proximal portion of the radius also has a well-developed bicipital tuberosity, turned slightly inward from the shaft of the ulna, for insertion of the biceps. Moreover, the distal portion of the radius is very much expanded anteromedially above the prominent styloid process. This expansion supports the place of insertion for the distal end of the supinator longus muscle which had its origin on the well-developed supinator ridge of the humerus.

Remains of the manus include the scapholunar and the third and fifth metacarpals. The scaphoid, lunar, and centrale are fused, although a groove showing the line of separation between the scaphoid and lunar can be seen across a portion of the radial facet. The distal facets for articulation with the magnum, unciform, and trapezoid are deeply concave and separated from one another by sharp angles. The metacarpals appear short and stout, a characteristic noted in machairodonts in comparison with true felids.

TABLE 2.—Measurements (in millimeters) of the limb bones of *Machaeroides eothen*, U. S. N. M. No. 17059

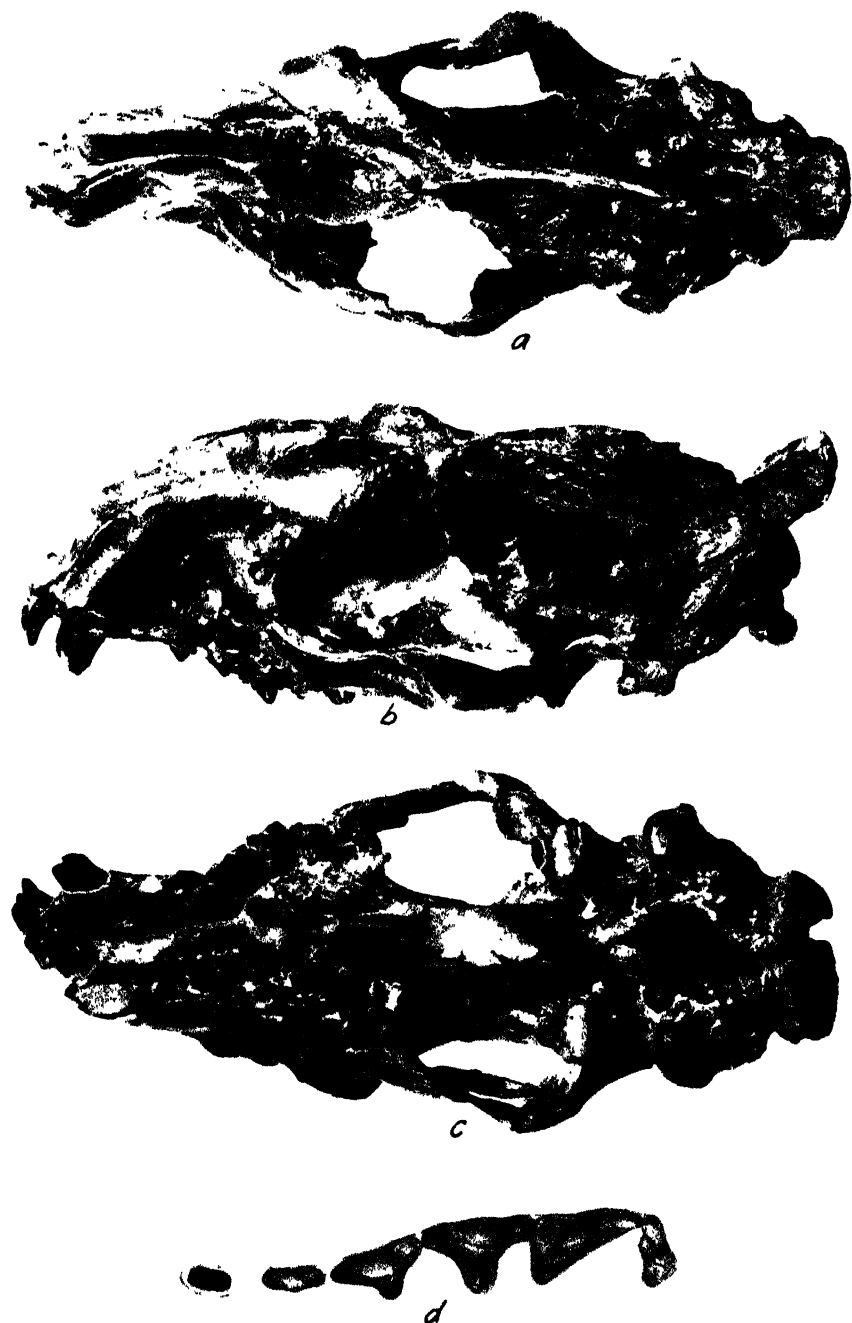
Length of humerus.....	104
Anteroposterior diameter of proximal end of humerus.....	26.5
Transverse diameter of proximal end of humerus across tuberosities.....	28
Transverse diameter of distal end of humerus.....	31.5
Greatest length of radius.....	76.8
Greatest diameter of proximal end of radius.....	13.5
Greatest diameter of distal end of radius.....	18.3
Length of ulna .....	102
Anteroposterior diameter of olecranon below tuberosities.....	13.5
Greatest diameter of distal end of ulna .....	13
Greatest length of scapholunar.....	13
Length of metacarpal III.....	27
Length of metacarpal V.....	21
Length of femur parallel to axis of shaft .....	118
Diameter of proximal end of femur across head and greater trochanter, perpendicular to axis of shaft.....	3.35
Transverse diameter of shaft of femur at midsection .....	17.5
Transverse diameter of distal end of femur across condyles, excluding tuberosities.....	16
Transverse diameter of distal end of femur across tuberosities.....	18

Both femora are preserved although the right is partly damaged. This element is longer and sturdier than in *Linnocyon verus* but otherwise has about the same curvature. The greater trochanter, though exhibiting an enlarged, rugose surface, does not project upward so far as in *L. verus*. The lesser trochanter is a posterointernal knoblike process situated at about the same height on the shaft as in *L. verus*, but the third trochanter is distinctly higher or more proximally located on the shaft, only slightly lower than the lesser trochanter. The distal extremity is relatively flattened on the dorsal surface and the patellar trochlea not so long as in *L. verus* but with the depression carried upward on the shaft well beyond the termination of the articulating surface.

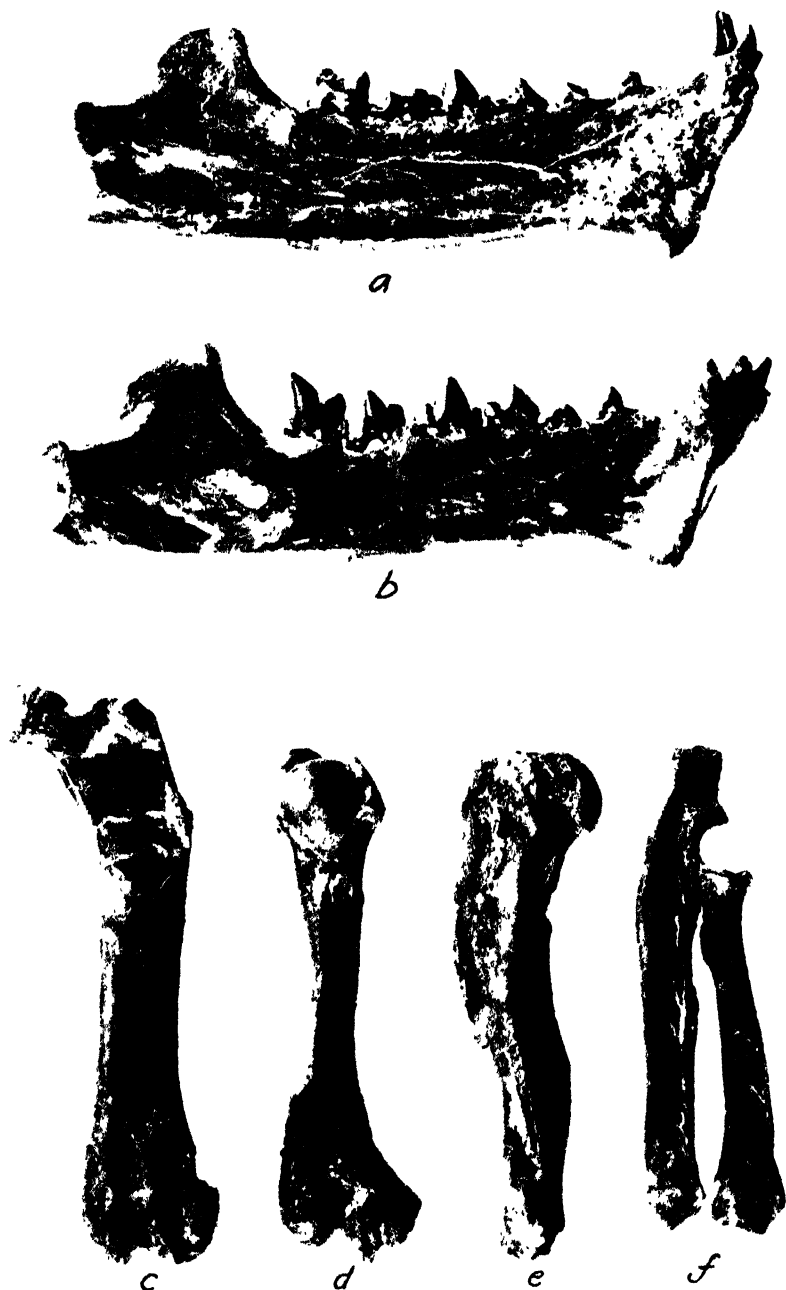
The preserved portion of the tibia is relatively robust, and curved, as described for *L. verus*, but the cnemial crest is prominent and extends distally a greater distance. The proximal extremity is missing but the posterior surface shows a rather deep groove between the ridges supporting the condyles, emphasized in part by crushing. The distal extremity may not be entire. It terminates in a simple, nearly flat surface with a steep dorso-lateral slope for articulation with the astragalus. The internal malleolus may not extend much below the facet for the astragalus, but it is incomplete.







*Machaeroides cothen* Matthew. Skull (U.S.N.M. No. 17059): *a*, Dorsal view; *b*, lateral view; *c*, ventral view; *d*, occlusal view of upper cheek teeth. Bridger Eocene, Wyoming. *a-c* three-fourths natural size; *d*,  $1\frac{1}{2}$  natural size. Drawing (*d*) by Mrs. Aime M. Awl.



*Machaeroides cothen* Matthew. *a, b*, Mandible (U.S.N.M. No. 17059): *a*, lingual view of left ramus; *b*, lateral view of right ramus. *c, f*, Limb bones (U.S.N.M. No. 17059): *c*, anterior view of left femur; *d*, posterior view of left humerus; *e*, medial view of right humerus; *f*, lateral view of right radius and ulna. Bridger Eocene, Wyoming. *a, b* natural size; *c-f* three-fifths natural size.



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## REVIEW OF SOME CHALCIDOID GENERA RELATED TO CEROCEPHALA WESTWOOD

By A. B. GAHAN

THIS review of some genera related to *Cerocephala* Westwood was occasioned by difficulty experienced in placing satisfactorily specimens received for identification. It is hoped that the following treatment will eliminate some of the existing confusion regarding these genera and make identification somewhat more certain.

*Cerocephala* and its allies have been associated by most authors with the genus *Spalangia* Latreille to form a subfamily Spalangiinae or a tribe Spalangiini in the family Pteromalidae. In my opinion *Cerocephala* and its allies are not closely related to *Spalangia* and should form a separate group for which I propose the name Cerocephalinae. Although resembling each other in many respects, the two groups have quite different host relations and can be separated by several good characters. The Spalangiinae are all parasitic in dipterous puparia, while the Cerocephalinae so far as known are all associated with Coleoptera.

The Spalangiinae and Cerocephalinae may be separated by the following dichotomy:

Hind tibia with one calcarium. Antennae inserted at the extreme anterior margin of head, never separated at base by a frontal carina; funicle always 7-segmented. Forewing without a callus or tuft of bristles at the proximal end of the marginal vein and without transverse fuscous bands; scutellum usually with a punctate cross furrow before apex Spalangiinae Westwood  
Hind tibia with two calcaria. Antennae inserted well above extreme anterior margin of head although frequently distinctly below ventral extremities of eyes, always separated at base by a frontal carina or prominence; funicle 5- or 6-segmented, or rarely 7-segmented in some males. Forewing

always with a callus at proximal end of marginal vein, this callus frequently but not always bearing a tuft of erect bristles; usually with a transverse fuscous band behind stigmal vein and another at juncture of submarginal and marginal veins but occasionally without bands; scutellum without a cross furrow before apex Cerocephalinae, new subfamily

Because of their bicalcarate hind tibiae the cerocephalines would run to the family Miscogasteridae in Ashmead's key to families of Chalcidoidea (Mem. Carnegie Mus., vol. 1, p. 228, 1904), and in that group, as constituted by Ashmead, they closely resemble some apterous forms in the subfamily Lelapinae, from which they differ principally by the absence of a neck on the propodeum and by differences in the shape of the head. I do not consider the Miscogasteridae to be separable as a family from the Pteromalidae. Instead, I think it should be combined with the Pteromalidae to form a large family made up of numerous smaller groups including the Cerocephalinae, Spalanginae, and Lelapinae among numerous others.

### Family PTEROMALIDAE

#### CEROCEPHALINAE, new subfamily

Eight genera are here included in the Cerocephalinae, viz: *Choetospila* Westwood, *Theocolax* Westwood, *Cerocephala* Westwood, *Theocolaxia* Girault, *Paralaesthia* Cameron, *Acerocephala* new genus, *Neosciatheras* Masi, and *Sciatherellus* Masi. No representatives of *Paralaesthia*, *Neosciatheras*, and *Sciatherellus* have been available for study, and they are placed in the generic key solely on the basis of the descriptions. No doubt some genera have been omitted that eventually may prove to belong here.

Four genera that have previously been associated by some authors with *Cerocephala* and *Spalangia* have been excluded from Cerocephalinae. These genera are discussed at the end of the paper.

*Description*.—Head varying in shape from subcircular to distinctly oblong; below antennae usually concave, the margins of concavity frequently armed with one or more sharp protuberances or teeth on each side; if not concave then face with striae converging toward clypeus; antennae inserted at or below middle of head but always distinctly above clypeus and always separated at base by a raised carina or narrow plate which is frequently but not always produced anteriorly to form a sharp tooth or spine between the antennae; malar groove absent; occiput carinately margined above; head attached to neck of pronotum very close to vertex. Pronotum large, subconical, sloping from posterior margin to neck without any abrupt angulations either dorsally or laterally; parapsidal grooves distinct and complete; axillae either

just touching at the median line or narrowly separated; scutellum nearly flat, without a cross furrow; propodeum not declivous, its dorsum lying in a plane only a little lower than that of scutellum, without carinae or lateral folds and not produced into a neck posteriorly; prepectus moderately large, triangular; mesopleuron with a weak femoral impression. Wings either present or absent; when winged, marginal vein of forewing as long as submarginal or longer, with a distinct callus or thickening at its juncture with submarginal, this callus often but not always bearing a tuft of erect bristles; stigmal vein never more than one-fourth as long as marginal, usually much shorter; postmarginal vein never longer than stigmal, usually weak, and sometimes absent; discal cilia absent or vestigial but marginal cilia moderately long and dense; hind wing unusually large with the marginellian vein usually longer than submarginella. Forewing usually with one or two fuscous areas or cross bands. Hind tibia with two slender, unequal, and often very short spurs. Abdomen petiolate; ovipositor usually shortly exerted, rarely half as long as abdomen; gaster of female subcylindrical, sometimes flattened above or a little compressed from the sides; of male compressed dorsoventrally and subtruncate at apex. Tegument of head and thorax usually smooth and polished, occasionally sculptured.

#### KEY TO THE KNOWN GENERA OF CEROCEPHALINAE

1. Funicle 5-segmented in the female, 6-segmented in the male; club solid in both sexes. Forewing with a tuft of erect bristles at junction of submarginal and marginal veins (apterous and subapterous individuals of both sexes common) 1. *Choetospila* Westwood
- Funicle 6-segmented in female, 6- or 7-segmented in male; club of female either solid or indistinctly 3-segmented; club of male may be solid, distinctly 2-segmented or indistinctly 3-segmented. Forewing with or without a tuft of erect bristles at junction of submarginal and marginal veins (apterous forms occur) 2
2. Head, pronotum, mesoscutum, and scutellum sculptured; axillae obliquely sulcate; forewing without a tuft of bristles at junction of marginal and submarginal veins 7
- Head dorsally, and mesoscutum entirely smooth and polished; pronotum usually smooth but sometimes sculptured; axillae and scutellum usually polished but sometimes more or less striated; forewing with or without a tuft of bristles 3
3. Mandibles unusually long and conspicuous 6
- Mandibles normal 4
4. Antennae inserted very distinctly below a line connecting lower extremities of eyes; head viewed anteriorly as long as broad or longer with sides parallel; subapterous or fully winged; fully developed wing with a tuft of bristles at juncture of submarginal and marginal veins, postmarginal vein absent or represented by merely a short stub.

2. *Theocolax* Westwood

Antennae inserted higher up, never more than slightly below a line connecting lower extremities of the eyes; head viewed anteriorly usually narrowing below, rarely with the sides nearly parallel; forewing with or without a tuft of bristles at juncture of submarginal and marginal veins; postmarginal vein distinct but never longer than stigmal vein 5

5. Forewing with a distinct tuft of bristles at juncture of submarginal and marginal veins 3. *Cerocephala* Westwood  
Forewing with a callus but without a tuft of bristles at juncture of submarginal and marginal veins 4. *Theocolaxia* Girault
6. Mandibles bidentate at apex; forewing with a tuft of bristles at juncture of submarginal and marginal veins 5. *Paralaesthia* Cameron  
Mandibles with four distinct teeth at apex; forewing with a callus but without a tuft of bristles at juncture of submarginal and marginal veins 6. *Acercephala*, new genus
7. Female: Antennae clavate, inserted a little below middle of head; scape not extending above vertex; first funicular joint about twice as long as pedicel; postmarginal vein subequal to stigmal vein, the latter rather short, the stigmal knob armed with a short tooth.

7. *Neosciatheras* Masi

Male: Antennae very long, filiform, inserted a little above middle of head; scape extending above vertex; funicular segments and club elongate, cylindrical; pedicel short; postmarginal vein nearly effaced; stigmal vein long, straight, and with the stigmal knob scarcely developed and unarmed 8. *Sciatherellus* Masi

### 1. Genus *CHOETOSPILA* Westwood

*Choetospila* WESTWOOD, Thesaurus entomologicus Oxoniensis, p. 137, 1874.

*Choetospila* DALLA TORRE, Catalogus hymenopterorum, vol. 5, p. 207, 1898.

*Spalangiomorpha* GIRAULT, Mem. Queensland Mus., vol. 2, p. 333, 1913.

*Choetospila* has been treated as a synonym of *Cerocephala* Westwood by Ashmead (Mem. Carnegie Mus., vol. 1, p. 369, 1904) and others but may be easily distinguished from that genus by the 5-segmented funicle of the female.

*Spalangiomorpha* was synonymized with *Choetospila* by Girault (Insecutor Inscitiae Menstruus, vol. 5, p. 37, 1917) and later with *Cerocephala* by the same author in one of his privately published pamphlets [Indications (in new insects) of ruling power in nature, p. 3, 1925]. In a still later publication Girault (Trans. and Proc. Roy Soc. South Australia, vol. 53, p. 319, 1929) again referred to the genotype species, using the generic name *Spalangiomorpha* but pointing out that the species agreed with *Choetospila* as characterized in a table of genera by Masi (Nov. Zool., vol. 24, p. 188, 1917). I agree with Waterston (Rep. Grain Pest Committee, No. 9, p. 25, fig. 13, 1921) that *Spalangiomorpha* is certainly a synonym of *Choetospila* Westwood.

*Type of the genus.*—*Choetospila elegans* Westwood.

## CHOETOSPILA ELEGANS Westwood

## PLATE 47, FIGURES 1, 1a

*Choetospila elegans* WESTWOOD, Thesaurus entomologicus Oxoniensis, p. 157, pl. 25, fig. 10, 1874.—WATERSTON, Rep. Grain Pest Committee, No. 9, p. 25, fig. 13, 1921.

*Spalangiomorpha fasciiventris* GIRAULT, Mem. Queensland Mus., vol. 2, p. 334, 1913.

*Spalangia metallica* FULLAWAY, Proc. Hawaiian Ent. Soc., vol. 2, p. 286, 1913. (New synonymy.)

*Spalangiomorpha fasciiventris* Girault is certainly the same as *Choetospila elegans*, as was pointed out by Waterston in the report cited above. Both the description and the habitat lead to this conclusion.

The type of *Spalangia metallica* Fullaway is in the collection of the U. S. National Museum, and it differs in no way from typical *C. elegans*.

*Choetospila elegans* is parasitic upon stored grain weevils and has been distributed to many parts of the world in shipments of stored products. The National Museum collection contains specimens from various parts of the United States, Mexico, Puerto Rico, Panama Canal Zone, Surinam, Peru, Hawaii, Guam, South Australia, Java, India, Nigeria, and South Africa. Published records include many additional areas where the species occurs.

Very little seems to be known about the actual biology of *C. elegans* beyond the fact that it is usually associated with pests of stored grain. Its most common host apparently is the rice weevil, *Sitophilus oryza* (Linnaeus). *S. granaria* (Linnaeus), *S. linearis* Herbst, *Sitodrepa panicea* (Linnaeus), *Caulophilus latinasus* Say, *Callosobruchus quadrimaculatus* (Fabricius), and *C. chinensis* (Linnaeus) have been recorded as attacked by it. Very likely other grain-infesting beetles may serve as hosts, but no authentic records of such hosts have been published. A paper by Corbett and Miller (Federated Malay States Dept. Agr. Sci., ser. 13, p. 4, 1933) recording this species as a parasite of *Sitotroga cerealella* Olivier is not available for judgment as to the authenticity of the record. Squire (Diel Rep. Dept. Agri. British Guiana for 1924, pp. 121-124, 1925) records *C. elegans* as parasitizing an unidentified scolytid infesting British Honduras mahogany trees (*Swietenia humilis*) in Guiana, and in the U. S. National Museum collection are 14 specimens of *C. elegans* labeled as having been reared by J. Zetek in 1924 in the Panama Canal Zone from a scolytid-infested piece of "Amargo" wood (*Vatairea* sp.).

The species is sufficiently characterized by the descriptions and figures given in the above-cited papers by Westwood and Waterston.



**CHOETOSPILA FRATER** (Girault), new combination

*Spalangiomorpha frater* GIRAULT, Mem. Queensland Mus., vol. 2, p. 334, 1913.

No representative of this Australian species is available for study. According to the description it differs from *elegans* principally by having the first funicular joint wider than long.

**CHOETOSPILA TABIDA**, new species

## PLATE 47, FIGURES 2, 2a

This species is very similar to *elegans* but differs by having distinctly shorter antennae, by being entirely wingless in both sexes (so far as shown by the specimens at hand), by the propodeum being smooth and polished, by the ovipositor of the female not extending beyond the apex of the abdomen, and by the antennal club being unsegmented in both sexes.

*Female*.—Length 1.6 mm. Mostly smooth and polished, the head anteriorly, below level of insertion of antennae, weakly wrinkled, and the mesopleura reticulated.

Head viewed from in front a little longer than broad, nearly squarely truncate at vertex and at mouth, and with the sides practically parallel; compound eyes very small, subobsolete; ocelli represented merely by minute punctures; antennae inserted low down at approximately the lower fifth of head, separated at base by a sharp carina; scrobes short and shallow, poorly defined; face slightly depressed medially, with a small toothlike projection at the anterior margin on each side of clypeus; mandibles rather broad and stout. Head viewed laterally forming a rather broad ellipse, approximately twice as long as broad.

Antenna 8-segmented, strongly clavate, short, its total length only slightly greater than the frontal length of head; scape short, slightly thickened, about three times as long as broad; pedicel about half as long as scape and half as long as funicle; funicle 5-segmented, the segments all transverse and gradually increasing in width toward club; club ovoid, large, very nearly as long as entire funicle, approximately twice as long as broad and apparently not segmented.

Thorax a little narrower than head, approximately twice as long as broad; prothorax subconical, rounded at the sides, more than twice as long as mesoscutum; parapsidal grooves complete, very oblique; scutellum as long as mesoscutum, nearly circular; mesopleuron weakly reticulated; metapleuron polished; propodeum slightly longer than scutellum, weakly convex dorsally, without grooves or carinae, smooth and polished except for some very faint reticulation basad of the spiracles. Wings entirely absent.

Legs rather stout, the middle pair obviously somewhat shorter

and weaker than the other two pairs; anterior femur obviously swollen and its tibia a little thickened, each with a few moderately long hairs on its ventral margin and a few shorter ones on its outer face; posterior femur slightly swollen, with a few short hairs; posterior tibia slender at base but gradually increasing in thickness toward apex, sparsely hairy and with two rather long and slender but unequal calcaria; tarsi not thickened; posterior basitarsus equal to half the length of tibia.

Abdomen nearly as long as head and thorax combined, a little broader than thorax; petiole as long as broad, smooth; gaster elliptical in outline, twice as long as broad, smooth and polished dorsally and ventrally, nearly devoid of hairs dorsally but with numerous rather long slender bristles at apex beneath; first segment of gaster emarginate medially; ovipositor not protruding beyond apex of abdomen.

Head, thorax, legs, and abdominal petiole brownish yellow; anterior and posterior coxae whitish except dorsally; antennae concolorous with head except that club is usually, though not always, blackish; gaster wholly black or blackish.

*Male*.—Length 0.9 mm. Antennae uniformly testaceous, 9-segmented; funicle 6-segmented, the first four segments very short and difficult to distinguish, the last two larger; club solid, conical, a little longer than two preceding segments combined; abdomen about as long as thorax. Otherwise like the female and difficult to distinguish from it.

*Type locality*.—University Park, Md.

*Type*.—U. S. N. M. No. 57279.

*Remarks*.—Described from five females (one holotype) and one male collected by W. H. Anderson as pupae from the burrows of an unidentified cossonine beetle infesting a dead branch of an unidentified tree and reared to adults.

## 2. Genus THEOCOLAX Westwood

*Theocolax* WESTWOOD, Philos. Mag., ser. 3, vol. 1, p. 127, 1832.

*Laesthia* HALIDAY, Ent. Mag., vol. 1, p. 335, 1833.

*Theocolax* is very similar to *Cerocephala*, and it has been treated as a synonym by Walker (Ent. Mag., vol. 2, p. 148, 1833). It may be distinguished from *Cerocephala*, however, by having the antennae inserted distinctly below a line connecting the lower extremities of the eyes, the head viewed anteriorly as long as broad or a little longer, parallel-sided, and never with more than three small toothlike projections, one between the antennae and one on each side of the facial depression just above the base of each mandible. In some species the processes above the bases

of the mandibles are absent. Both subapterous and fully winged individuals occur. In the fully winged individuals there is a distinct tuft of erect hairs at the juncture of the marginal and submarginal veins of the forewing, exactly as in *Cerocephala*. The postmarginal vein is absent or represented by merely a short stub.

*Type of the genus.*—*Theocolax formiciformis* Westwood.

THECOLAX FORMICIFORMIS Westwood

PLATE 47, FIGS. 3, 3a; PLATE 48, FIGS. 1, 1a, 1b

*Theocolax formiciformis* WESTWOOD, Philos. Mag., ser. 3, vol. 1, p. 127, 1832;

Thesaurus entomologicus Oxoniensis, p. 138, pl. 25, fig. 11, 1874.

*Laesthia vespertina* HALIDAY, Ent. Mag., vol. 1, p. 336, 1833.

*Cerocephala formiciformis* (Westwood) WALKER, Ent. Mag., vol. 2, p. 149, 1834.

I examined Westwood's type of this species in the Hope Museum at Oxford, England, in 1927 and compared with it a specimen from Blankenburg, Thuringia, previously identified by Schmiedeknecht. This specimen, now in the U. S. National Museum, appeared to me to be homotypic. The National Museum collection also contains one specimen identified by Ruschka and said to have been reared from *Anobium striatum* Olivier at Stockholm, Sweden. This specimen is considerably paler in color than the homotype but does not seem to differ otherwise. In addition to these two specimens the collection possesses a series of 14 specimens from Auckland, New Zealand, said to have been reared from *Anobium*-infested timber by E. Bollard and D. Spiller. Apparently this series does not differ materially from the homotype except that one female in the lot has fully developed wings. Except for the perfectly developed wings, this winged specimen is exactly like the subapterous females.

Although the species has usually been described as wingless, as a matter of fact, in none of the individuals I have seen are the wings completely absent, usually being represented by small stubs approximately twice the length of the tegula. In the fully winged individual the postmarginal vein is represented by merely a very short stub; the marginal vein is a little longer than the submarginal; the stigmal vein is approximately one-sixth as long as marginal, slightly curved and not thickened at apex; the disk of wing is nearly bare; the marginal cilia are moderately long, and there is an erect tuft of black bristles at the junction of marginal and submarginal veins. There is a broad fuscous cloud embracing the apical half of the marginal and all of the stigmal vein and extending across the wing. The hind wing is about two-thirds as

wide as the forewing and rounded at its apex. The propodeum is weakly reticulated and slightly shining.

*Theocolax formiciformis* appears to be a common parasite of *Anobium*, having been recorded from several species of that genus. It is also said by several authors to attack (*Hylesinus*) *Leperisinus fraxini* (Panzer), but since it is known to have been confused in some instances with *Cerocephala cornigera* Westwood, a common parasite of this host, it seems very likely that all of the records of *Theocolax formiciformis* from *Leperisinus fraxini* actually refer to *Cerocephala cornigera* as was suggested by Waterston (Rep. Grain Pests Committee, No. 9, p. 12, 1921).

The species is known to occur in England, Sweden, Germany, and New Zealand and may be much more widely distributed. It is not known to occur in America.

**THEOCOLAX BAKERI** (Crawford), new combination

*Cerocephala bakeri* CRAWFORD, Philippine Journ. Sci., vol. 9, p. 460, 1914.

This Philippine species differs from *formiciformis* by being distinctly smaller, by lacking the toothlike protuberances on each side of the facial depression, and by the pedicel in the female being as long as the first and second segments of the funicle combined. It is also somewhat paler in color. All known specimens of the species are fully winged and have a conspicuous tuft of bristles at the junction of the marginal and submarginal veins. The head is oblong with parallel sides and with the antennae inserted distinctly below the ventral extremities of the eyes.

There are eight specimens in the U. S. National Museum, inclusive of the type series, all taken by C. F. Baker at Los Baños, Philippine Islands. One of these bears a label "on scolytid No. 847."

**THEOCOLAX LITIGIOSA** (Rondani)

*Laesthia litigiosa* RONDANI, Ann. Soc. Nat. Modena, vol. 1, p. 23, 1866; Arch. Zool., vol. 4, p. 191, pl. 7, fig. 7-8, 1866; Bull. Soc. Ent. Ital., vol. 9, p. 183, pl. 1, fig. 29, 1877.

*Theocolax litigiosa* DALLA TORRE, Catalogus Hymenopterorum, vol. 5, p. 207, 1898.

It is impossible to recognize this species from the short and very unsatisfactory descriptions by Rondani. The alleged host (a species of Cecidomyiidae) justifies a doubt that *litigiosa* belongs in *Theocolax*.

**3. Genus CEROCEPHALA** Westwood

*Cerocephala* WESTWOOD, Mag. Zool., vol. 2, Cl. IX, pl. 4, 1832.

*Epimacerus* WALKER, Ent. Mag., vol. 1, p. 368, 1833.

*Sciatheras* RATZBURG, Die Ichneumoniden der Forstinsecten . . . , vol. 2, p. 209, 1848.

*Parasciatheras* MASI, Nov. Zool., vol. 24, p. 189, 1917. (New synonymy.)

*Proamotura* GIRAULT, Insecutor Inscitiae Menstruus, vol. 8, p. 143, 1920 (new synonymy).—DODD (in part), Mem. Queensland Mus., vol. 9, p. 66, 1927.

On a succeeding page I have indicated that the genotypes of *Epimacrus* and *Sciatheras* are both synonyms of *Cerocephala cornigera* Westwood, the genotype of *Cerocephala*. This generic synonymy has been recognized by most authors for many years.

*Parasciatheras* was proposed as a subgenus of *Cerocephala*. The characters given in Masi's key for distinguishing the subgenus from *Cerocephala* do not function satisfactorily, and while there are certain differences between the two genotypes in head characters, these seem to be of no more than specific value. Accordingly the subgenus is suppressed.

*Proamotura*, described by Girault as a genus of Cleonymidae but compared by its author with *Spalangia* Latreille and *Spalangiomorpha* Girault, differs from *Cerocephala* only in minor head characters and some details of sculpture. Such differences as exist are at most of specific value only. Dodd redescribed *Proamotura aquila* Girault, the genotype, and placed in the genus three additional Australian species. All the species treated by Dodd, except the genotype, lack the tuft of erect bristles at the apex of the submarginal vein and are here transferred to *Theocolaxia* Girault.

#### CEROCEPHALA CORNIGERA Westwood

PLATE 47, FIGS. 4, 4a; PLATE 48, FIG. 3

*Cerocephala cornigera* WESTWOOD, Mag. Zool., vol. 2, Cl. IX, pl. 4, 1832.

WALKER, Ent. Mag., vol. 2, p. 149, 1834.

*Epimacrus rufus* WALKER, Ent. Mag., vol. 1, p. 369, 1833.

*Sciatheras trichotus* RATZBURG, Die Ichneumoniden der Forstinsecten . . . vol. 2, p. 209, pl. 3, fig. 1, 1848.

*Epimacrus rufus* Walker was synonymized with *C. cornigera* by Walker, and this synonymy has been generally accepted. Although I have not seen Walker's type, I believe the synonymy to be correct.

*Sciatheras trichotus* Ratzeburg has been considered a synonym by most authors but Masi (Nov. Zool., vol. 24, p. 188, 1917) expresses the opinion that it may be different from *cornigera*. In 1927 I examined the type of *Sciatheras trichotus* in the Ratzeburg collection at the Förstliche Hochschule in Eberswalde, Germany, and made the following notes upon it:

*Female*.—Head thick, occiput margined; a prominent toothlike carina between bases of antennae; face concave below antennae, with two small prominences on each lateral margin of the excavation; antenna strongly clavate, flagellum gradually increasing in

thickness from base of funicle to club, the latter pointed-ovate; first funicular segment one and one-half times as long as broad, second and third about as long as broad, fourth to sixth more or less slightly broader than long; club apparently solid, a little longer than two preceding segments; mesonotum smooth, parapsidal grooves deeply impressed, axillae smooth; scutellum nearly flat, smooth, except for some very minute and obscure reticulations apically. Propodeum granularly rugulose, without carinae, folds, or spiracular sulci, and nearly horizontal. Abdomen as long as thorax or a little longer, slightly compressed, shortly petiolate; ovipositor not quite half as long as abdomen. Marginal vein of forewing nearly as long as submarginal, with a tuft of black hairs at juncture of the two veins; postmarginal and stigmal veins short and subequal.

Subsequently during a visit to the Hope Museum at Oxford, England, I saw the type of *Cerocephala cornigera* Westwood and compared it with the above notes. This type is a male. Except for sexual characters it agreed with the notes on the Ratzeburg type.

Under the name *C. cornigera* in the British Museum general collection I found one headless female, and in the British collection one male also agreeing with my notes on the types.

The U. S. National Museum collection contains one female and a male reared by H. L. Parker in April 1936, at Hyères, France, from *Scolytus multistriatus* (Marshall) and identified by me as *C. cornigera*. The female agrees with my notes on the Ratzeburg type of *trichotus* as well as with the Ratzeburg description, and the male apparently differs from the type of *cornigera* only by having the thorax entirely dark ferruginous instead of more or less fuscous or blackish on the scutellum and propodeum. This difference is believed not to be of specific significance since in other related species there is known to be a similar variation in color.

There is but little doubt that *Choetospila elegans* Westwood and *Theocolax formiciformis* Westwood have both been confused with *Cerocephala cornigera* in the literature. As pointed out by Waterston [Rep. Grain Pests Committee, No. 9, p. 12, 1921], the records of this species as a parasite of stored grain pests almost certainly refer to *Choetospila elegans*. The record in Dours (Cat. Syn. Hym. France, p. 92, 1874) of *C. cornigera* from *Anobium pertinax* Fabricius very probably refers to *Theocolax formiciformis*. The listing of *cornigera* by Giraud and Laboulbène (Ann. Soc. Ent. France, ser. 5, vol. 7, p. 422, 1877) as a parasite

of Aphidae and of *Odynerus* sp. is quite certainly erroneous. The species apparently normally attacks scolytids of the genera *Leperisinus*, *Scolytus*, *Chaetoptelius*, and *Phloeotribus*. The most complete description of the species is that by Russo (Boll. Lab. Ent. Agr. Portici, vol. 2, pp. 206-215, figs. 105-110, 1938).

So far as known, *C. cornigera* is confined in its distribution to the European continent and the British Isles.

CEROCEPHALA ECCOPTOGASTRI Masi

*Cerocephala eccoptogastri* MASI, Ann. Mus. Civ. Stor. Nat. Genova, ser. 3, vol. 9, pp. 189-193, fig. 7, 1921.

Judged by Masi's description and figure as well as by the indicated host this species is very likely a synonym of *C. cornigera* Westwood. The types are said to have been reared from *Eccoptogaster* (probably *rugulosus* Ratzeburg) taken at Bengasi, Cyrenaica.

The figure published by Gonzales Ceballos (Las tribus de los Himenópteros de España, p. 204, 1943) under the name *Cerocephala eccoptogastri* Ratzeburg does not agree completely with Masi's description and figure. The head appears longer and apparently has only one tooth, instead of two, on each lateral margin of the facial depression. If the drawing is accurate it probably represents a species different from *eccoptogastri*. Ceballos has evidently confused the specific name with that of *Pachyceras eccoptogastri* Ratzeburg, an insect quite different from the one he figures.

CEROCEPHALA DINODERI Gahan

PLATE 47, FIGURE 5

*Cerocephala (Parasciatheras) dinoderi* GAHAN, Philippine Journ. Sci., vol. 27, p. 100, 1925.

As was pointed out in the original description, *dinoderi* is apparently very similar to *caelebs* Masi. The former was described from a unique female and the latter from a unique male. Subsequent to the description of *dinoderi*, the C. F. Baker collection of Hymenoptera was acquired by the U. S. National Museum, and in it were seven specimens of this species, one of them a male.

This male apparently differs from the description of *caelebs* by having the antennal flagellum much less conspicuously hairy, the hairs being very sparse and short, none of them as long as the segment from which it arises. The antennal club is much less distinctly segmented than in Masi's illustration of the antenna of *caelebs*, the dividing furrow being very shallow and indistinct. The striations on the face are present but appear to be somewhat weaker than illustrated for *caelebs*. The head dorsally, pronotum

posteriorly, mesoscutum, axillae, scutellum, and gaster are dark piceous with violaceous or metallic tints on the head and mesoscutum. The remainder of head and thorax, propodeum for the most part, and the abdominal petiole are rufotestaceous, the coxae all whitish and the remainder of legs somewhat paler than the underside of thorax but darker than the coxae. The abdominal petiole is a little longer than the posterior coxa, paler at base and at apex than in the middle, cylindrical, and granulosely punctate. The antennae are about twice as long as the length of the head, not at all clavate, consisting of a subcylindrical scape, a pedicel not quite twice as long as broad, one strongly transverse ring joint, seven funicular segments, and a club which is indistinctly 2-segmented, no thicker than the funicle, and about equal in length to the two preceding funicular segments. Funicular segments 1 to 4 are subequal, each about as long as the pedicel and narrowed at base; segments 5 to 7 are very slightly shorter and more compact. The sensilla are rather coarse and extend the whole length of the segments.

Described originally from Mount Maquiling, Luzón, Philippine Islands, as a parasite of *Dinoderus minutus* (Fabricius), this species has since been received from Buitenzorg, Java, where it is said to have been reared from *Calandra oryzae* (Linnaeus) by R. Awibowo. Other specimens in the collection, without host records, are from Laguna and Los Baños, Philippine Islands, and Deli, Sumatra.

CEROCEPHALA CAELEBS Masi

*Cerocephala* (*Parasciatheras*) *caelebs* MASI, Nov. Zool., vol. 24, p. 189, figs. 45-48, 1917.

This species was described from one male specimen collected in the Seychelles Islands.

It apparently differs from *dinoderi* Gahan mainly in the more distinctly hairy antennal flagellum.

CEROCEPHALA AQUILA (Girault)

PLATE 48, FIGURE 2

*Proamotura aquila* GIRAULT, Insecutor Inscitiae Menstruus, vol. 8, p. 143, 1920.—Dodd, Mem. Queensland Mus., vol. 9, p. 67, 1927.

*Cerocephala aquila* very closely resembles *dinoderi* but may be distinguished from that species, as well as all others, by the completely striated dorsum of the prothorax.

Head viewed from in front nearly circular; antennae inserted above lower extremities of eyes; face depressed medially, mostly smooth within the depression, and with a more or less distinct carina running down the middle; lateral margins of the facial depression with a broad, shallow, not very distinct incision oppo-



site the base of each antenna but without any distinct teeth or projections; laterad of the depression and below the antennae rather strongly striated; front above antennae, vertex, temples, and cheeks mostly smooth and polished; scrobicular grooves short and weakly reticulated, separated by a longitudinal carina which originates just below the anterior ocellus and which is flattened and produced to form a sharp prominence between the bases of the antennae. Antennae rather distinctly clavate in the female, filiform in the male. Pronotum dorsally finely and strongly longitudinally striated; mesoscutum and axillae perfectly smooth and polished, except in the grooves which are weakly foveolated; *scutellum smooth medially but distinctly longitudinally striated laterally*; propodeum rather strongly ruguloso-reticulate, occasionally with indications of a median carina but more often without. Abdominal petiole of female about half as long as posterior coxae, of male equal in length to hind coxae; gaster in both sexes smooth and shining, in female about as long as thorax, in male much shorter than thorax; basal segment of female gaster triangularly emarginate medially, of male not emarginate; ovipositor sheaths about as long as the petiole. Forewing in both sexes with marginal vein very nearly as long as submarginal; postmarginal vein slightly shorter than stigmal; discal cilia weak, marginal cilia moderately long; tuft of hairs at apex of submarginal vein strong. Color of head and thorax varying from mostly reddish brown to mostly yellowish testaceous, the gaster and ovipositor sheaths usually black or very dark brown; antennal club black, remainder of antenna and all legs concolorous with the head and thorax. Anterior wing with a small fuscous cross band at apex of submarginal vein, and a large one embracing the apical half of marginal vein and all of stigmal vein.

Girault described this species from specimens reared from beetle-infested twigs of *Mallotus philippinensis* collected at Brisbane, Australia. Dodd gave a more complete description and reported the species from two additional Australian localities. One specimen from Ayr, North Queensland, Australia, identified by Dodd, is now in the U. S. National Museum.

Besides this Australian specimen the National Museum now possesses the following material which I have identified as *aquila*: Two females from Sigatona, Fiji, "ex lyctid," R. A. Lever, coll., December 1942; one male from Mount Maquiling, Luzón, reared from *Dinoderus minutus* (Fabricius) in bamboo by C. F. Baker; one male from Los Baños, Luzón, "ex bostrichid on bamboo," reared by S. M. Candana; one male from Laguna, Luzón, collected

on laboratory window by D. T. Fullaway and I. Dobrosky; four females from Santiago de las Vegas, Cuba, reared from larvae of *D. minutus* by A. Otero, January 26, 1933, under Acc. No. 9802a; and a large series of specimens reared by E. A. Chapin from stems of *Arundinaria longifolia* (bamboo) infested with *Dinoderus minutus*, *Lyctus* sp., and two or three other species of Coleoptera, the bamboo stems having been discovered in storage in Hoboken, N. J., but said to have originally come from Mexico. Of the several species of Coleoptera reared from these stems, individuals of *Dinoderus minutus* were by far the most abundant and in all probability this species was the actual host of the parasite.

In view of the habit of this species of attacking larvae infesting bamboo, it seems likely that it will eventually be found to be much more widely distributed than the above few records show.

#### 4. Genus THEOCOLAXIA Girault

*Theocolaxia* GIRAULT, Lèse Majesté, new Insecta, and robbery, p. 1, 1924.

*Cratomus* DODD (not Dalman), Trans. Royal Soc. South Australia, vol. 48, p. 170, 1924.

*Proamotura* (Girault) DODD (in part), Mem. Queensland Mus., vol. 9, p. 66, 1927.

*Theocolaxia* was described in a single page, privately published, pamphlet printed at Gympie, Australia. The genus is monobasic, with *T. lessingi* Girault as its type. The short generic description is as follows:

"*Theocolaxia* nov. (Spalangiinae). Antennae 9-jointed, club solid, larger. Wings as *Neosciatheras* as to shape, venation, fringes. Pronotum square, exceeding mesoscutum. Parapsides shorter than scutum, convex. Axillar sutures meeting cephalad. Scutellum plane. Propodeum rugulose, irregular median and lateral carinae. Petiole short, abdomen ovate, equal rest, ovipositor  $\frac{3}{4}$  lt. Jaws 4-dentate."

Earlier in the same year A. P. Dodd described two Australian species in the genus *Cratomus* Dalman, but in 1927 he discovered they did not belong in Dalman's genus and transferred both species to *Proamotura* Girault. In the latter paper he described one new species and two new varieties, redescribed *P. aquila* the genotype of *Proamotura*, and gave a key for separating the species. According to the descriptions, all three of the species erected by Dodd differ from *aquila* Girault by lacking the tuft of erect bristles at the apex of the submarginal vein. Absence of this tuft is the most striking character differentiating the genus *Theocolaxia* from *Cerocephala* of which *Proamotura* is here considered to be a synonym. Accordingly I have transferred the three species described by Dodd to *Theocolaxia* and placed *Proamotura aquila* Girault in *Cerocephala*.

Two North American species described by Ashmead in *Cerocephala* also lack the tuft of hairs on the forewing and seem to agree, except in one respect, with the generic characters given in the descriptions by both Girault and Dodd. The male antennae of the only Australian species of which the male was known were described by Dodd as being 11-segmented consisting of a scape, pedicel, one ring joint, seven funicular segments, and an apparently solid club. A specimen identified by Dodd as a variety of that species is in the U. S. National Museum, and it agrees with that description. In males of the single North American species of which this sex is known, the antennae are 10-segmented, consisting of scape, pedicel, six funicular segments, and a distinctly 2-segmented club. No ring segment is visible, and the seventh segment beyond the pedicel, while closely resembling a funicular segment, is obviously more closely united with the apical segment than with the preceding and forms a part of the club. The antennae of the females of this species apparently do not differ from those of females of the Australian species, and the difference in the one sex I do not believe to be of generic importance.

**THEOCOLAXIA LESSINGI** Girault

*Theocolaxia lessingi* GIRAULT, Lèse Majesté, new Insecta, and robbery, p. 1, 1924.

This species is known only from the original description which is as follows: "*T. lessingi* nov. Black, glabrous; knees, tibia 1 beneath, tips tibiae, petiole red. Coxa 3, basal  $\frac{1}{3}$  ovipositor, white, also apex club. Antennae red save club, base pedicel, funicles 5-6. Fore wing with cross-stripe distal half marginal to apex stigmal, also a central spot off bend of submarginal. Funicle 1 equal pedicel. Sand dunes, Main Beach, Southport, May 5, 1924."

The type is probably in the Queensland Museum.

**THEOCOLAXIA VIRIDINOTUM** (Dodd), new combination

*Cratomus viridiotum* DODD, Trans. Royal Soc. South Australia, vol. 48, p. 171, 1924.

*Proamotura viridiotum* DODD, Mem. Queensland Mus., vol. 9, p. 72, 1927.

According to Dodd this species is distinguished from the other Australian species by the presence of only one fuscous band on the forewing.

It was described from Lord Howe Island, Australia.

**THEOCOLAXIA INSULARIS** (Dodd), new combination

*Cratomus insularis* DODD, Trans. Royal Soc. South Australia, vol. 48, p. 171, 1924.

*Proamotura insularis* (Dodd) DODD, Mem. Queensland Mus., vol. 9, p. 68, 1927.

Described from specimens said to have been reared from rotten wood, found on Lord Howe Island, Australia.

**THEOCOLAXIA INSULARIS** var. **GRANDIS** (Dodd), new combination

*Proamotura insularis grandis* DODD, Mem. Queensland Mus., vol. 9, pp. 64, 68, figs. 2, 3, 1927.

Both sexes of this variety were described from North Queensland, Australia, where they were collected on tree trunks.

One male paratype of this form was received from its author and is now in the National Museum collection. The antenna of this specimen is 11-segmented, the scape rather thick, pedicel slightly longer than broad, ring segment fully as long as broad and narrower than the following segment, funicle 7-segmented with all its segments about equal in width and diminishing slightly in length from first to last, the club solid but with slight indication of a cross furrow and about twice as long as but no wider than the preceding segment. The head has a broad elevation between the bases of the antennae, but this is not produced into a prominent tooth or spine as in most other species. The face is moderately convex and strongly striated, with only a very shallow groove running from each antennal fossa to the clypeus, the margins of these grooves rounded and without any sharp angles or protuberances. The scrobes are moderately deep with sharp lateral margins and extend very nearly to the anterior ocellus. The vertex is perfectly smooth but the frons between the scrobes and the eye margins is striated like the face. The area behind the eyes is sparsely covered with deep punctures. The whole dorsum of the thorax is polished, except that the parapsidal grooves are weakly foveolated and the axillar grooves strongly so. The propodeum is ruguloso-reticulate without distinct carinae. The abdominal petiole is cylindrical and distinctly longer than the hind coxae. The wings are ample, with the marginal vein distinctly much shorter than the submarginal, the postmarginal about as long as the stigmal.

The color is nearly uniformly black with a slight metallic tinge, the hind coxae, all tibiae and tarsi and the underside of abdomen more or less fuscotestaceous. The wings are hyaline with a fuscous band beneath the stigmal vein but without any indication of a band behind the apex of submarginal vein.

Dodd states that after comparing this form with typical *insularis*, no specific differences could be found. On account of the larger size (*insularis* 2.75 mm., *grandis* 4 to 4.75 mm.) and the darker wings, he thought it was advisable to separate this mainland form from the Lord Howe Island insect.

**THEOCOLAXIA PERPULCHRA** (Dodd), new combination

*Proamotura perpulchra* DODD, Mem. Queensland Mus., vol. 9, p. 70, 1927.

Described from one female collected at Mount Tambourine.

South Queensland, Australia. In Dodd's key to species, *perpulchra* is separated from *insularis* on the basis of a difference in the length of the abdominal petiole. This is said to be plainly longer than wide in *perpulchra* while females of *insularis* are said to have it transverse. The scutellum of *perpulchra* is said to be dull metallic green.

**THECOLAXIA PERPULCHRA** var. **METALLICA** (Dodd), new combination

*Proamotura perpulchra metallica* DODD, Mem. Queensland Mus., vol. 9, p. 71, 1927.

Described from collected specimens taken in Cairns district, North Queensland, Australia. According to Dodd this form is distinguished from typical *perpulchra* by its more extensive metallic coloration.

**THECOLAXIA SCOLYTIVORA** (Ashmead), new combination

PLATE 47, FIGURES 7, 7a

*Cerocephala scolytivora* (Ashmead MS.) RILEY and HOWARD, Insect Life, vol. 4, p. 122, 1891. (Nomen nudum.)

*Cerocephala scolytivora* ASHMEAD, Proc. Ent. Soc. Washington, vol. 3, p. 33, 1894.

This species was described from southern Florida as a parasite of the scolytid *Loganius ficus* Schwarz. The types are in the U. S. National Museum.

*Female*.—Length 1.8 mm. Head viewed from in front very slightly longer than broad, distinctly convex in outline dorsally and less strongly so below; antennae inserted very nearly on a line with ventral extremities of eyes; face below antennae distinctly concave, the depression sharply margined laterally; between bases of antennae is a strong protuberance which is flattened and delicately margined above and terminates in a sharp and slightly upturned point; margin of facial depression with a shallow incision laterad of base of antenna, the lower angle of this incision slightly prominent but not forming a distinct tooth; scrobes not extending to the front ocellus; ocelli in an obtuse triangle, ocellocular line about equal to distance between posterior ocelli; eyes not prominent, equal in length to approximately half the length of head. Vertex, upper part of frons, cheeks, and whole area behind eyes smooth and polished; frons laterad of scrobes and face laterad of the depression weakly rugulose; area within facial depression mostly smooth.

Antennae consisting of scape, pedicel, six funicular segments and club. Scape bottle-shaped, rather short, slender at base, rather abruptly thickened beyond basal one-third; pedicel slightly longer than broad; first funicular segment as long as pedicel and a little longer than broad, slightly longer than second; segments

2-6 subequal in length but successively increasing very slightly in width, the second about as broad as long and the sixth only a little broader than long; club indistinctly 3-segmented, ovate, and about equal in length to two preceding segments.

Thorax mostly smooth and polished, the neck of pronotum, mesopleura, and mesosternum weakly reticulated; pronotum longer than mesoscutum and as long as broad or a little longer; parapsidal grooves not foveolate; scutellum about as long as mesoscutum, nearly flat; axillae very nearly meeting; axillar grooves weakly foveolated and distinct but not deeply impressed; propodeum finely and shallowly reticulated, dull, without lateral folds or median carina. Anterior and posterior femora rather broad; middle femur more slender; posterior tibia with two slender, unequal calcaria. Anterior wing about three times as long as broad, nearly devoid of discal cilia, the marginal fringe moderately long; submarginal and marginal veins nearly equal, marginal about seven times as long as stigmal, postmarginal a little shorter than stigmal.

Abdomen nearly as long as head and thorax combined; petiole distinctly longer than broad, about two-thirds as long as posterior coxae, broader at base than at apex, flattened and smooth dorsally; gaster a little narrower than thorax, slightly compressed from the sides, smooth and polished, the first tergite the longest and deeply incised medially; ovipositor sheaths exerted approximately one-third the length of gaster and slightly compressed.

General color yellowish testaceous, the mesonotum slightly darker than the pronotum, the apical two-thirds of abdomen dorsally, dark brown; antenna nearly uniformly reddish testaceous, its club sometimes a little darker; legs generally very slightly paler than thorax, their coxae often more or less whitish; wings hyaline with a broad fuscous band behind apex of venation and a narrow indistinct one at apex of submarginal vein.

*Male*.—Length 1.5 mm. Almost exactly like the female except that the abdominal gaster in dried specimens is hardly longer than broad, compressed dorsoventrally and truncate at apex; petiole very nearly twice as long as broad; antennae scarcely distinguishable from those of female, its funicular segments a little more loosely articulated and the transverse groove setting off basal segment of club deeper and more distinct. Unlike the male of *insularis*, the male of *scolytivora* shows no visible ring segment in the antenna, the funicle is 6-segmented and the club distinctly 2-segmented.

Redescribed from the type series comprised of nine females and six males.

## THECOLAXIA PITYOPHTHORI (Ashmead), new combination

## PLATE 47, FIGURE 8

*Cerocephala pityophthori* (Ashmead MS.) RILEY and HOWARD. Insect Life, vol. 4, p. 123, 1891.

*Cerocephala pityophthori* ASHMEAD, Proc. Ent. Soc. Washington, vol. 3, p. 32, 1894.

Originally described from four specimens now in the National Museum collection and said to have been reared from *Pityophthorus consimilis* LeConte taken at Haw Creek, Fla.

Agrees with the description of *scolytivora* except in the following particulars:

*Female*.—Length 1.4 mm. Frons laterad of scrobes and face laterad of the depressed area below the antennae more weakly sculptured, nearly smooth; antenna with the basal segments of flagellum more slender, a little narrower than pedicel, the first and second funicular segments subequal, each about as long as broad and each a little shorter than pedicel; club about as long as three preceding segments combined. Anterior and posterior femora more slender. Marginal vein a little longer than submarginal. Abdomen about as long as thorax, the petiole only slightly broader at base than at apex, about twice as long as broad; ovipositor one-third to nearly one-half as long as gaster. General color reddish testaceous, the vertex, dorsum of thorax, and whole of gaster piceous and more or less strongly tinged with a metallic sheen; legs reddish piceous, with the anterior and posterior coxae whitish except basally; antenna reddish, the club and usually the last funicular segment piceous; wings hyaline with a broad fuscous band embracing the stigmal vein and about the apical two-fifths of marginal vein, but without a band at apex of submarginal vein; ovipositor yellowish basally, the apical half blackish.

Male unknown.

Redescribed from the four females comprising the type series, and two females from Durham, N. C., said to have been reared from *Thysanoes fimbriicornis* LeConte, December 13, 1942, by C. L. Massey.

## 5. Genus PARALAESTHIA Cameron

*Paralaesthia* CAMERON, Biologia Centrali-Americana, Hymenoptera, vol. 1, p. 110, pl. 5, fig. 15, 15a, b, c, and f, 1884.

This genus, with *P. mandibularis* Cameron as its only included species, is unknown to me except by Cameron's description and figures. It is apparently related to *Acerocephala* but differs, according to the description, by having the mandibles three-fourths as long as the head and bidentate at apex, by having "a

wide and deep furrow extending from behind the ocelli to the antennae and carinated in the middle, the keel running down to the centre." The marginal vein is said to be longer than the submarginal, and there is a tuft of hairs at the junction of the two veins.

Cameron's figures of the male and female apparently differ so widely in characters of the head as to raise a suspicion that they are not congeneric. The male should be considered the holotype.

Described from Panama.

#### 6. Genus ACEROCEPHALA, new genus

Because of the differently shaped head, greatly elongated mandibles, and the absence of a tuft of hairs at the juncture of the submarginal and marginal veins of the forewing, it seems advisable to remove *Cerocephala atrovioacea* Crawford from *Cerocephala* and erect a new genus for it. The new genus apparently resembles *Paralaesthia* Cameron, but if Cameron's description is accurate they may be readily separated by the characters used in the key. *Acerocephala* differs further by the absence of any groove or depression down the middle of the frons.

*Female*.—Head large, viewed from in front subrectangular, very slightly broader at mouth than at vertex, its dorsal line nearly straight, its ventral line (when the mandibles are closed) squarely truncate, its sides straight and diverging slightly below; face deeply impressed; lateral margins of facial depression rounded, without projections; clypeus not defined; labrum large, completely exposed; mandibles large, about one-third as long as the length of head, squarely truncate at apex and each with four subequal short teeth; eyes small, not prominent, obviously much less than half the length of head; ocelli in a slightly obtuse triangle; ocellocular line approximately equal to distance between posterior ocelli; scrobes deep anteriorly, shallower above, not reaching to anterior ocellus; between the antennae a high, narrow, dorsally flattened plate originating some distance below anterior ocellus and either abruptly truncated or gradually declivous from a point just below the antennal foveae. Antennae inserted distinctly below the ventral margins of eyes, 9-segmented; scape slender at base, becoming thicker in apical two-thirds, about four times as long as broad, not compressed; pedicel pyriform, about one and one-half times as long as broad; funicle 6-segmented, the segments all narrower at base than at apex, subequal in length but successively increasing in breadth; first funicular segment as long as or longer than broad and no longer than pedicel, sixth very slightly broader than long; club ovate, solid.



with very slight indication of one transverse groove, very slightly longer than last two funicular segments combined and a little thicker than preceding segment. Pronotum a little longer than broad, narrowed anteriorly into a distinct neck; mesoscutum broader and shorter than pronotum, about twice as broad as long; parapsidal grooves deep, complete, and not foveolate; scutellum about as long as mesoscutum, weakly convex; axillae just meeting; axillar furrow not or very weakly foveolated; propodeum not declivous, about half as long as scutellum, without either median carina or lateral folds and with very shallow spiracular sulci; mesopleuron with a very shallow, nonfoveolated, femoral impression; prepectus moderately large, triangular; anterior and posterior coxae large, subequal; middle coxae much smaller; anterior femora distinctly swollen, as large as or larger than posterior pair; posterior tibia with two slender, unequal calcaria. Abdomen about as long as thorax, somewhat compressed from the sides, distinctly petiolate; petiole broader at base than at apex, flattened and smooth dorsally; basal segment of gaster deeply, triangularly incised at apical middle; ovipositor sheaths exerted about one-fifth to one-third the length of gaster. Forewing about three times as long as broad; marginal vein longer than submarginal; stigmal vein approximately twice as long as broad; postmarginal weak and not longer than stigmal; discal cilia vestigial; marginal cilia short; juncture of marginal and submarginal veins with a small but distinct callous but without a tuft of bristles. Posterior wing about two-thirds as broad and six-sevenths as long as anterior wing.

*Male*.—Antenna resembling that of female but 10-segmented, the club distinctly 2-segmented and with slight indication of a second cross furrow; first funicular segment nearly as long as pedicel. Abdomen a little shorter than thorax, compressed dorsoventrally, subtruncate at apex, the apical segments retracted; petiole a little broader at base than at apex; basal segment of gaster not so deeply incised at apical middle as in female. Otherwise like female.

*Type of the genus*.—*Cerocephala atrovioleacea* Crawford.

ACEROCEPHALA ATROVIOLACEA (Crawford), new combination

PLATE 48, FIGURE 5

*Cerocephala atrovioleacea* CRAWFORD, Proc. U. S. Nat. Mus., vol. 45, p. 314, 1913.

*Female*.—Length about 3 mm. Black, tinged with purple on head, underside of thorax and abdomen; thorax above faintly tinged with green; narrow border around the mouth, mandibles,

scape, and pedicel rufotestaceous; flagellum black and shining; abdomen with the petiole more or less rufous, the gaster black slightly diluted with red basally; legs concolorous with thorax except all tarsi and more or less of anterior tibiae reddish testaceous. Wings hyaline, the forewing with a brownish transverse band embracing all of stigmal vein and approximately the apical two-fifths of marginal vein; venation brownish, the callus black.

Body mostly smooth and polished; head mostly smooth but with scrobal cavity, narrow border along each side of scrobes, and the sloping inner walls of facial depression weakly aciculated and ventral surface of head weakly reticulated; raised plate between antennae polished dorsally, narrowly wedge-shaped, broadest anteriorly, and abruptly perpendicularly truncate just below antennae; labrum squarely truncate at apex; scrobal grooves deep and extending more than half the distance from antennal foveae to anterior ocellus; neck of pronotum weakly reticulated; mesopleura reticulated; propodeum for the most part very finely transversely lineated, smooth posteriorly; abdominal petiole obviously a little longer than broad and a little broader at base than at apex; gaster entirely smooth and polished, not quite as long as thorax; ovipositor slightly exserted, never more than one-fifth as long as gaster.

*Male*.—Unknown.

*Remarks*.—Redescribed from the type series and two subsequently acquired specimens. The types were reared from a scolytid infesting cones of pinyon (*Pinus edulis*) at Las Vegas, N. Mex. The two more recently acquired specimens are labeled as having been reared from *Conophthorus edulis* Hopkins infesting cones of *Pinus edulis* at Ute Pass, Colo., and are recorded under Hopkins U. S. No. 9099e.

ACEROCEPHALA AENIGMA, new species

PLATE 47, FIGURES 6, 6a; PLATE 48, FIGURES 4, 4a

The specimens upon which this species is based were at first believed to represent merely a varietal form of *atroviolacea*. More careful examination of the few specimens available has shown certain apparently constant characters by which they differ from *atroviolacea*, however, and makes it appear necessary to treat them as a separate species.

*Female*.—Length 2.75 mm. Agreeing with the description of *atroviolacea* except in the following particulars: Body shining black with no suggestion of green on dorsum or elsewhere; pedicel and apex of scape piceous; aciculations on front of head stronger

and the sculptured area obviously more extensive, embracing most of the area between the eyes from a little below the anterior ocellus to oral margin but smooth along inner orbits; raised plate between antennae very faintly aciculated dorsally, narrowly elliptical anteriorly and not perpendicularly truncated but sloping gradually from just below antennae to oral margin; labrum broadly rounded anteriorly; scrobal grooves relatively shallow and extending upward a little less than half the distance from antennal foveae to anterior ocellus; neck of pronotum a little more strongly reticulated; petiole of abdomen a little broader than long and nearly twice as wide at base as at apex; ovipositor exerted approximately one-third the length of gaster.

*Male*.—Length 2.5 mm. Very similar to the female except antenna somewhat longer and abdomen squarely truncate at apex. Antenna with 10 distinct segments and with more or less indication of another division on the club; scape approximately four times as long as thick, somewhat thickened in apical half; pedicel longer than thick; funicle 6-segmented, the first segment very slightly shorter than pedicel, about one and one-half times as long as broad, following segments subequal to the first in length but successively increasing slightly in width, the fifth and sixth a little broader than long; club a little broader than last funicular segment and a little longer than two preceding segments combined, its first segment closely resembling a funicular segment but a little less distinctly set off from the following segment. Abdominal petiole about as broad as long, faintly sculptured and broader at base than at apex; basal segment of gaster apparently broadly but not deeply emarginate at apex.

*Type locality*.—Prineville, Oreg.

*Type*.—U.S.N.M. No. 57280.

*Remarks*.—Holotype female, allotype, and one female paratype labeled as having been reared from *Pinus ponderosa* at Prineville, Oreg., June 2, 1935, by W. J. Buckhorn under Hopkins U. S. No. 18977D; one female paratype from *Pinus ponderosa*, Hackamore, Calif., June 6, 1931, by K. A. Salman under Hopkins U. S. No. 20755D; and one female paratype from *Pinus coulteri*, Mount Laguna, Calif., November 1940, by D. DeLeon under Hopkins U. S. No. 32842D.

#### 7. Genus NEOSCIATHERAS Masi

*Neosciatherus* MASI, Nov. Zool., vol. 24, pp. 189-192, figs. 49, 50, 1917.

*Neosciatheras* is unknown to me except by the description. The genotype, *N. laticeps*, described in the same paper as the genus, is based upon a single female collected in the Seychelles Islands.

The genus apparently differs from all others treated here, except *Sciatherellus* Masi, by having the head and thorax distinctly sculptured instead of mostly smooth and polished. From *Sciatherellus*, known only in the male sex, it may be distinguished by the characters used in the key.

The antennae are said to be clavate, inserted below the middle of face but a little above a line connecting the lower extremities of the eyes, 10-segmented, without a ring segment, the funicle 6-segmented and the club indistinctly 2-segmented. The head, viewed from in front, is nearly as broad as long, the eyes prominent, and the cheeks curved. The axillae are rugoso-sulcate, and the scutellum similarly but less strongly sculptured. The propodeum has a deep, semielliptical, transverse excavation basally. The forewing is without a tuft of hairs at the juncture of marginal and submarginal veins, the marginal vein is about eight times as long as the rather short stigmal vein, the stigmal knob is armed with a short tooth, and the postmarginal vein is a little shorter than the stigmal. The wing beyond the basal cell is said to be yellowish gray ("flavido-grisescens") with the transverse fascia behind the juncture of marginal and submarginal veins and the macula adjacent to the stigmal vein obscure, the apical margin pallid. The abdominal petiole is almost as long as the propodeum, cylindrical and finely striated, and the gaster is about as long as thorax, smooth and shining, its first segment not incised at dorsal margin. The ovipositor is exerted one-third the length of gaster.

#### 8. Genus *SCIATHERELLUS* Masi

*Sciatherellus* MASI, Nov. Zool., vol. 24, pp. 189, 192, figs. 51, 52, 1917.

The type species, *S. oryctinus* Masi, described in the same paper as the genus, was based on a single male specimen collected in the Seychelles Islands.

This genus, like *Neosciatheras* Masi, apparently differs from the other genera in this group by having the mesonotum punctate. It differs from *Neosciatheras* according to the description by having the stigmal vein about one-fourth as long as the marginal, the stigmal knob only slightly developed and without a process, the postmarginal vein almost effaced, the antennae inserted a little above the middle of head, the scape extending above the level of vertex, the flagellum very long and not thickened, and the propodeum without a transverse fovea at base. The forewing is without a tuft of bristles at the juncture of marginal and submarginal veins and has two transverse fuscous bands. The head, viewed from in front, is a little broader than long, and the face is obliquely striate without projections.

## SPECIES WRONGLY PLACED IN CEROCEPHALINAE

One species described in *Theocolax* is quite certainly not a cerocephaline but a eupelmid.

## EUELMELLA CANADENSIS (Provancher), new combination

*Theocolax canadensis* PROVANCHER, Nat. Canad., vol. 14, p. 35, 1883; Faune entomologique du Canada, p. 809, 1887.

*Cerocephala canadensis* (Provancher) ASHMEAD, Proc. Ent. Soc. Washington, vol. 3, p. 33, 1894.

No representative of this species has been seen by me but the description of the thorax cannot apply to any cerocephaline and does agree quite well with some of the subapterous eupelmids. O. Peck, of the Canadian Department of Agriculture, informs me that he once examined the type of the species in the Provancher collection and concluded it was a eupelmid but did not place it generically. It is here referred tentatively to *Eupelmella Masi* but may eventually prove to belong in some other subapterous genus of the Eupelmidae.

Ashmead's translation of Provancher's description is incorrect with respect to the mesothorax. This is said to be longitudinally hollowed out, not "longitudinally aciculated" as stated by Ashmead.

## REMARKS ON SOME GENERA EXCLUDED FROM CEROCEPHALINAE

The following genera, which at one time or another have been associated by some authors with *Cerocephala* in the Spalanginae, are considered not to belong in Cerocephalinae:

*Paraspalangia* Ashmead (Mem. Carnegie Mus., vol. 1, p. 334, 1904) was included in a key to genera of Spalanginae with a manuscript species, *P. annulipes* Ashmead, named as the genotype. The type of this species is in the National Museum collection, and it belongs in the Tetrastichinae. The type specimen was redescribed by Girault (Ann. Ent. Soc. Amer., vol. 9, p. 303, 1916) under a new generic and specific name, *Stigmatotrastichus emersoni* Girault. The generic name *Stigmatotrastichus* Girault is a synonym of *Paraspalangia* Ashmead, and the specific name *emersoni* Girault a synonym of *annulipes* Ashmead. This synonymy was indicated in the list of type species of the genera of chalcid flies by Gahan and Fagan (U. S. Nat. Mus. Bull. 123, p. 137, 1923) but without indication of where the genus belonged in the classification.

*Pegoscapus* Cameron (Ann. Rep. Estación Central Agronómica Cuba, p. 275, 1906), assigned to the Spalanginae by Cameron and included in the treatment of that group by Schmiedeknecht (Gen-

era insectorum, fasc. 97, pp. 385, 386, 1909), has not been seen by me, but is certainly a fig insect (Agaonidae) as stated by Waterston (Trans. Ent. Soc. London, 1920, p. 129).

*Tricoryphus* Foerster (Hymenoptera Studien, vol. 2, p. 46, 1856) was originally described without included species. Thomson (Hymenoptera Scandinaviae, vol. 4, p. 209, 1875) redescribed the genus and included *T. fasciatus* Thomson which is the genotype. Ashmead (Mem. Carnegie Mus., vol. 1, p. 392, 1904) treated the genus as a synonym of *Cerocephala*, but Masi (Ann. Mus. Civ. Stor. Nat. Genova, ser. 3, vol. 9, p. 240, 1921) declared it to be a good genus. The U. S. National Museum collection possesses two female specimens from "Deutschland" identified by Foerster as *Tricoryphus* and bearing an unpublished Foersterian specific name. These specimens agree with Thomson's description of *Tricoryphus fasciatus*. In my opinion, based upon these specimens, the genus *Tricoryphus* is closely related to *Apterolelaps* Ashmead and *Spalangiolaelaps* Girault and should be referred to the subfamily Lelapinae.

*Spalangiopelta* Masi (Ann. Mus. Civ. Stor. Nat. Genova, ser. 3, vol. 10, p. 30, 1922) is unknown to me except by the description. Masi states that it is intermediate between Asaphini and Spalangiini. The 13-segmented antenna with three distinct ring segments, the presence of the malar grooves, the unexcavated face, the subobsolete parapsidal grooves, the presence of a transverse groove on the scutellum, the distinctly sculptured thorax and the metallic green color seem to exclude it from close relationship with *Cerocephala*. I am unable to place it definitely.

## EXPLANATION OF PLATES

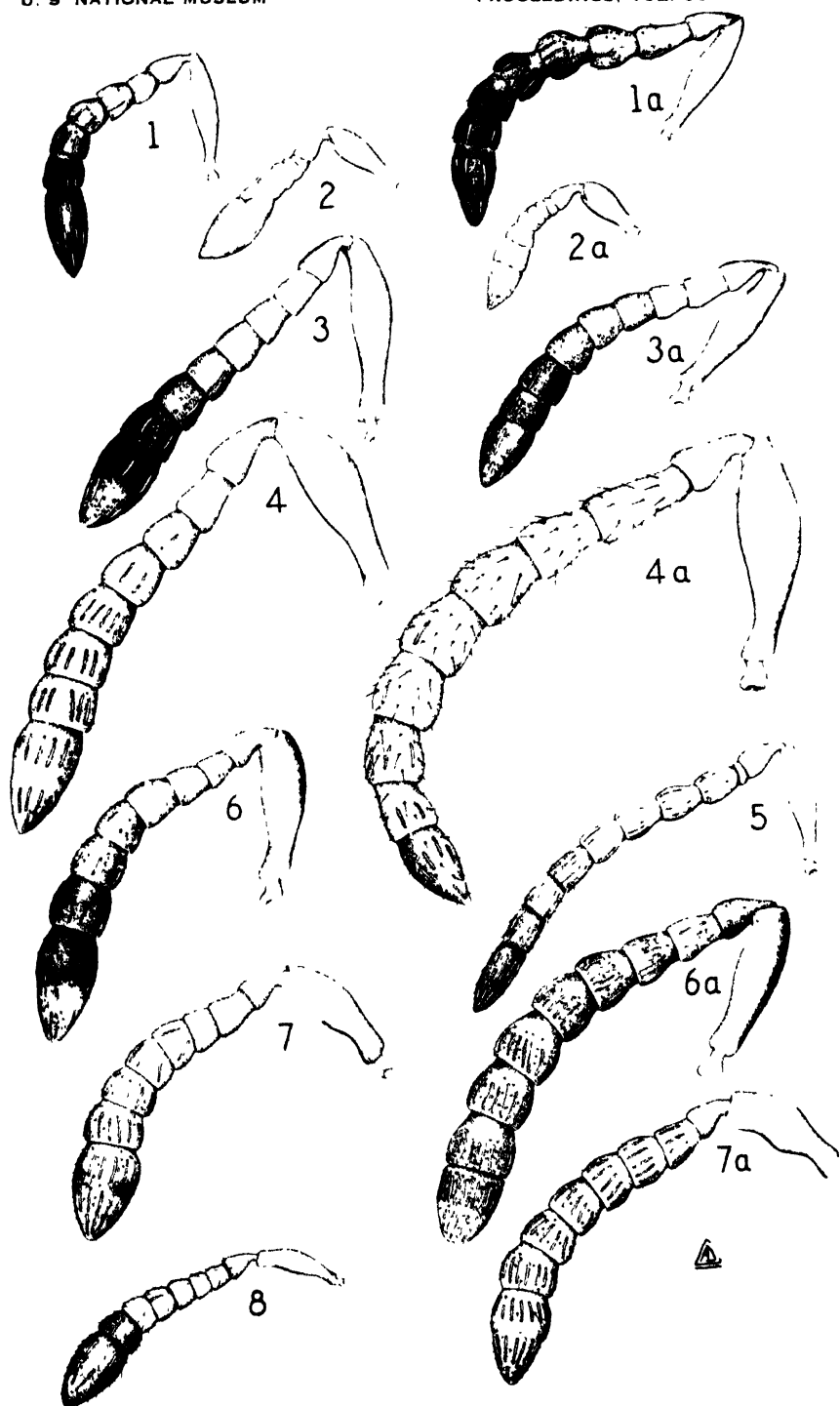
The drawings for the accompanying plates were made by Arthur Cushman, of the Bureau of Entomology and Plant Quarantine, U. S. Department of Agriculture.

### PLATE 47

- 1-1a. *Choetospila elegans* Westwood: 1, Antenna of female; 1a, antenna of male.
- 2-2a. *Choetospila tabida*, new species: 2, Antenna of female; 2a, antenna of male.
- 3-3a. *Theocolax formiciformis* Westwood: 3, Antenna of female; 3a, antenna of male.
- 4-4a. *Cerocephala cornigera* Westwood: 4, Antenna of female; 4a, antenna of male.
- 5. *Cerocephala dinoderi* Gahan: Antenna of male.
- 6-6a. *Acerocephala aenigma*, new genus and species: 6, Antenna of female; 6a, antenna of male.
- 7-7a. *Theocolaxia scolytivora* (Ashmead): 7, Antenna of female; 7a, antenna of male.
- 8. *Theocolaxia pityophthori* (Ashmead): Antenna of female.

### PLATE 48

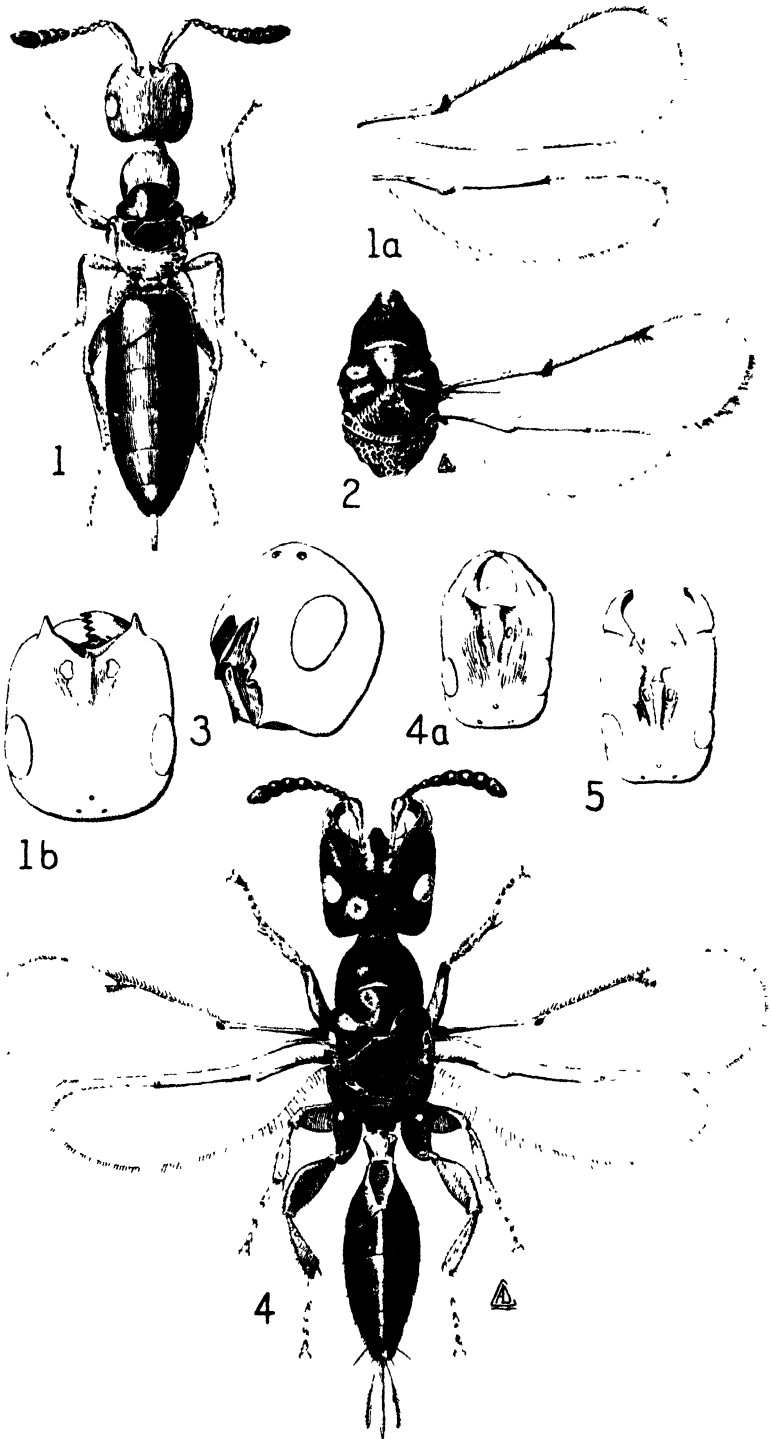
- 1-1b. *Theocolax formiciformis* Westwood: 1, Apterous female; 1a, anterior and posterior wings from female of alate form; 1b, head of female, anterior view.
- 2. *Cerocephala aquila* (Girault): Thorax and wings of female.
- 3. *Cerocephala cornigera* Westwood: Head of female in semiprofile.
- 4-4a. *Acerocephala aenigma*, new genus and species: 4, Complete drawing of female; 4a, anterior view of head of female.
- 5. *Acerocephala atroviolacea* (Crawford): Anterior view of head of female.



SPECIES OF CHOETOSPILA, THECOLAX, CEROCEPHALA,  
ACEROCEPHALA, AND THECOLAXIA.

FOR EXPLANATION SEE PAGE 376.





SPECIES OF THECOLAX, CEROCEPHALA, AND ACEROCEPHALA.  
FOR EXPLANATION SEE PAGE 376.



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A REVISION OF THE GENERA OF MULLET, FISHES OF  
THE FAMILY MUGILIDAE, WITH DESCRIPTIONS OF  
THREE NEW GENERA

By LEONARD P. SCHULTZ

DURING my recent studies of the mullets of Venezuela I became interested in the generic relationships of the Mugilidae and attempted to define the genera of this group of fishes. To accomplish this I examined specimens of the mugilid species that have been made genotypes, basing my diagnoses on specimens in the United States National Museum. The numerous genera of the family have not been well defined, and I failed to locate any key or contribution in which all the genera of the world were compared. This study is a provisional one. Much more work needs to be done before the various genera are thoroughly understood, especially in regard to those centering around *Mugil* and *Chelon* as herein defined. My conclusions were made after several hundred specimens from most parts of the world were examined; the material used is summarized under each genus. No attempt is made to place under each genus all the species that may belong there, since that task would require the reexamination of the types of all described species, scattered in museums throughout the world.

Several ichthyologists have studied the Mugilidae, presenting in keys or diagnoses their understanding of certain genera. Among the recent ones may be mentioned Jordan and Evermann (U. S. Nat. Mus. Bull. 47, pt. 1, p. 809, 1896); Oshima (Ann. Carnegie Mus., vol. 13, p. 241, 1922); Weber and de Beaufort (The Fishes of the Indo-Australian Archipelago, vol. 4, p. 230, 1922); Mohr (Zool. Jahrb., vol. 54, pp. 195-200, 1927); and Roxas (Philippine Journ. Sci., vol. 54, No. 3, pp. 393-396, 1934). Dr. J. L. B. Smith (Ann.

South African Mus., vol. 30, pp. 587-589, 1935) has reviewed in an excellent manner the problems concerning the confusion in regard to African mugilid species and their diagnoses, but he did not attempt to solve the problem as to what genera are valid. His discussion of characters used in describing mullets is worthy of considerable thought, inasmuch as it applies in general to generic descriptions.

Despite the large amount of material examined, I have experienced great difficulty in arranging the species of Mugilidae into genera of concise and of clear definition, owing mostly to the paucity of useful taxonomic characters and somewhat to the inadequate descriptions that abound in the literature. Nevertheless, I have constructed a key to the genera that is practical, though artificial in itself, and that I believe defines the natural generic units as observed.

The type of *Agonostomus bryanti* Bean and Weed, which I have examined, belongs to the genus *Hypseleotris* Gill in the family Eleotridae. It is not a mullet.

The family Mugilidae as recognized by authors is remarkably constant in anatomical structures as far as investigated by me; the number of vertebrae is usually 24 or 25, with 11 to 13 abdominal and 11 to 13 caudal. The relative positions of the fins are uniform, and there is no outstanding example of a great increase in number of fin rays in any genus. Among other characters the shape of body, with depressed head anteriorly, spiny preorbital, broad scaly interorbital, large scales on head and body, two dorsal fins well separated, the first with peculiarly arranged spines, are characteristic of all mullets.

Among the characters studied it appears that the mouth parts of mugilid fishes have evolved and specialized, whereas the other anatomical structures have remained more or less constant for most of the genera. Therefore, I have studied the preorbital, nostrils, teeth, jaws, and other mouth parts rather carefully in search of characters suitable for defining and recognizing mugilid genera. In most genera the teeth remain fairly constant in structure at all sizes beyond the very immature, but in *Mugil* there is evidence that some of the tips are simple in the young, becoming bifid or even trifid in very large adults. It is a well-established fact, also, that in certain species young mullets have two anal spines, but half grown and adults have three anal spines. Recent American authors refer to the immature stage of the mullet with two anal spines as the "querimana stage." The adipose eyelid is another character that develops with age, usually appearing at standard lengths of 30 to 50 mm. and reaching the highest development in the adults, or else being absent at all ages.

The key that follows is based on specimens of 40 mm. and over, but one should be able by it to identify mullets to genera at lengths of half that or shorter. It is a preliminary step in the definition of mugilid genera, based on the genotypes and other species referred to the genera recognized.

- 1a. Ventral side of mandible with 4 bluntly rounded fleshy lobes, free posteriorly; two strips of transverse, close-set, membranous lamellae along lateral edge of lower jaw on each side externally; mandible bluntly pointed; lower jaw included, without teeth; upper jaw with a narrow band of villiform teeth; nostrils close together; no adipose eyelid; upper lip forming tip of snout; scales ctenoid (fresh and brackish waters of western tropical Pacific).

**Cestraeus Valenciennes**

- 1b. Mandible without the 4 fleshy lobes and lamellae as described above.

2a. Upper lip not forming anterior tip of head; snout fleshy, bluntly rounded, forming anterior tip of head, snout projecting in front of upper lip, the latter narrow, inferior in position; lower jaw included; no adipose eyelid; scales ctenoid.

3a. Upper jaw with a band of incisorlike multicuspid teeth inside of thick lips; each side of lower jaw with a patch of multicuspid teeth widely separated at symphysis; nostrils very close together in front of eye; margin of lower jaw rounded, lower lips thick; no symphyseal knob at middle of lower jaw and no notch in middle of upper lip; scales ctenoid (fresh waters of Central America, Mexico, and Cuba) . . . . . **Joturus Poey**

3b. Upper and lower jaws with fine teeth in a single row in each jaw, tips simple, none of the teeth with bifid or multicuspid tips; nostrils at side of head at lower level of orbit, widely spaced, the posterior closer to eye than to anterior nostril; margin of lower jaw angular, not rounded, with a symphyseal knob and upper lip with pit to receive it; maxillary and premaxillary not hooked downward, lower lip thin-edged, teeth in both jaws ciliiform, posterior edge of preorbital very narrow, and anterior edge nearly straight, not with a concavity; scales ctenoid (fresh waters, rarely in brackish water, India) . . . . . **Rhinomugil Gill**

2b. Upper lip forming anterior tip of head and not inferior in position below a projecting fleshy snout.

4a. Upper and lower jaws with thick lips, a distinct wide band of teeth inside of lips, but no teeth on margin of lips; lower lip not directed or folded downward; tips of teeth of inner rows on upper jaw bifid or trifid, those on lower jaw simple or bifid; anterior margin of lower jaw broadly rounded; maxillary reaching past front of orbit and past posterior tip of preorbital bone; lower lip thick, not thin at edge and not bearing teeth; no adipose eyelid; nostrils close together; scales ctenoid (fresh waters, tropical New World westward to Hawaiian Islands and Mauritius, New Zealand, and New South Wales).

**Agonostomus Bennett**

4b. Teeth and lips not as in 4a.

5a. Lower lip thick-edged, without thin edge and not directed forward horizontally but folded or directed downward so that lower lip fits more or less snugly behind upper lip when mouth is closed; margin of lower jaw angular.

6a. Lower lip bearing setiform teeth externally on edges, these arranged in a narrow or wide band.

7a. Both lips with broad edges bearing externally a band of minute teeth in several close-set rows, most of teeth having bifid tips; lower lip directed but not folded downward and without free inner edge; teeth minute, slender, with bifid tips, arranged in numerous close-set rows on upper pharyngeals; nostrils very close together; no adipose eyelid; rear end of preorbital bone

several times wider than space between nostrils; scales ctenoid (marine, in Pacific Ocean of tropical New World).

**Chaenomugil** Gill

- 7b. Both lips with narrow edges bearing externally a narrow band of setiform teeth in 2 or 3 rows; lower lip folded downward and largely free along its inner edge.

8a. Margin of lips of both jaws with characteristic 3-pointed setiform teeth set in 2 or 3 rows; adipose eyelid obsolete or undeveloped; nostrils moderately separated, much closer together than anterior is from edge of snout, lip excluded; maxillary not reaching past rear edge of preorbital bone; scales cycloid (marine, Oceania)..... **Neomyxus** Steindachner

8b. Margins of both lips with a uniserial row (occasionally a few in an outer or second row) of setiform teeth with unbranched curved tips; adipose eyelid well developed (except nearly absent in young) in adults, reaching almost to pupil; nostrils, about as far apart as anterior is from edge of snout, lip excluded; scales cycloid (marine, Galápagos Islands).

**Xenomugil**, new genus

- 6b. Lower lip bearing several rows of fleshy papillae, both externally and internally, with their tips crenulate, becoming more so in adults a foot long or longer; upper lip very broad, bearing papillae, the crenulate edge continuous around rictus with crenulate lower lip; nostrils close together, the anterior one as close to premaxillary groove as to posterior nostril; front edge of preorbital with an angular or concave notch; premaxillary and maxillary bent downward posteriorly but tip of maxillary not exposed as in *Chelon*; adipose eyelid undeveloped or absent; scales cycloid (marine, Oceania and Indian Ocean)..... **Crenimugil**, new genus
- 5b. Lower lip with a thin edge, directed horizontally forward or nearly so, not folded downward and not bearing teeth externally on lips although fine teeth may occur along edge of lip; upper lip with a band of teeth or with a uniserial row of setiform or ciliform, or small incisorlike teeth, sometimes more or less firmly set.
- 9a. Adipose eyelid well developed, reaching to or nearly to pupil except on young 50 mm. in standard length or shorter, in which case posterior edge of preorbital narrower than space between nostrils; distance between nostrils wide, equal to or greater than width of upper lip; anterior and posterior nostrils widely separated, farther apart than anterior nostril is from groove that separates upper lip from rest of snout; posterior edge of preorbital narrower (fig. 28, a-c) than distance between nostrils and its posterior tip scarcely or not reaching past front of eye; maxillary and premaxillary not hooked downward and maxillary not notably exposed; maxillary and premaxillary in line with front edge of preorbital; no teeth on vomer or palatines; scales cycloid (marine, along coasts of Europe, Africa, Asia, North and South America, West Indies, Oceania to Red Sea, islands of Atlantic and Pacific Oceans in temperate and tropical waters)..... **Mugil** Linnaeus
- 9b. No adipose eyelid; distance between nostrils narrow, contained 2 or more times in width of upper lip; anterior nostril much closer to posterior nostril than anterior is from groove that separates upper lip from rest of snout; width of posterior edge of preorbital wider than distance between nostrils.

10a. Teeth setiform or ciliform, in upper lip with simple undivided tips.

11a. Teeth numerous in upper jaw in a single row, with simple tips rather coarse and incisorlike, firmly set, not ciliform, and not forming part of upper lip, but exposed; anterior edge of preorbital straight or nearly so; maxillary nearly straight, not notably exposed or hooked downward over the premaxillary (fig. 29, *a-c*) and not extending past rear edge of preorbital bone; premaxillary with its anterior margin evenly curved, the nondentate posterior part in line with toothed portion, not at sharp angle to it; narrow band of teeth on vomer and palatines; scales cycloid (marine and fresh waters, Australian region and tropical western Pacific)----- **Myxus** Günther

11b. Teeth in upper jaw ciliform, flexible, extremely fine and numerous, forming part of upper lip.

12a. Anterior edge of preorbital concave or angular; maxillary with its posterior part notably exposed, sharply curved downward over posterior part of premaxillary (fig. 30, *a-d*) and extending below preorbital a distance greater than width between nostrils; premaxillary with its front margin sharply angular, nondentate posterior portion hooked backward and downward almost at right angles to toothed portion; villiform patches of teeth on vomer and palatines present or absent; scales cycloid (marine, tropical and temperate Atlantic, Pacific, and Indian Oceans of Old World, not yet found in New World).

**Chelon** Röse

12b. Anterior margin of preorbital evenly curved or nearly straight (fig. 31, *a-c*); maxillary with its posterior part somewhat exposed but in line with posterior part of premaxillary and not curved downward, but ending about opposite posterior edge of preorbital; premaxillary with its front margin evenly curved; a narrow band of villiform teeth present on vomer and palatines; scales ctenoid (fresh waters, possibly brackish too, Australia, Burma, and South Africa)----- **Trachystoma** Ogilby

10b. Teeth in upper lip setiform rather firmly set, with trifold or bifid tips; teeth in lower jaw ciliform and embedded more or less in thin edged lower lip; anterior edge of preorbital concave; maxillary with its posterior part notably exposed, sharply curved downward over posterior part of premaxillary and extending below preorbital a distance greater than width between nostrils; premaxillary with its front margin sharply angular, nondentate posterior portion hooked backward and downward at a sharp angle; villiform patches of teeth on vomer and palatines; scales cycloid (marine, South Africa).

**Heteromugil**, new genus

In speculating on the relationships among the genera of Mugilidae, I should assume that the most primitive mullet had undergone the least amount of specialization. Such a mullet should retain largely unmodified teeth in bands on jaws, vomer, and palatines. The

anterior edge of the preorbital bone would be straight, and the maxillary and premaxillary with nearly straight contour would extend in line with the straight preorbital edge. The lips would not be specialized with a thin edge or with modified teeth and papillae. Among the genera recognized herein, *Agonostomus* comes nearest to fitting the above group of characters and may be considered as nearest the ancestral stock of the family.

The accompanying figure 32 is presented to show in a graphic manner some of the probable structural relationships common to certain mugilid genera. *Joturus* with its projecting snout and broadly attached gill membranes may represent the most specialized genus, more or less in the general line of descent from an *Agonostomus*-like mullet.

*Rhinomugil* is an aberrant genus. The nasal openings are low on the side of the head, in line with the lower edge of the orbit. No other mullet appears to be closely related to this genus.

The remaining genera of mugilid fishes appear to have two general lines of specialization, which could have arisen from a mugilid stock not greatly unlike *Mugil* as defined in this preliminary revision. This genus has the straight front edge of the preorbital and nearly straight contour of maxillary and premaxillary in line with front edge of preorbital. The lower lip is thin but unmodified. The first line of specialization, as represented by *Chelon*, *Crenimugil*, and *Heteromugil*, has a concave front edge of preorbital with strongly bent premaxillary and maxillary bones posteriorly, usually exposed below the preorbital. The lips and teeth may or may not be specialized. The second line of specialization represents a group of genera, namely *Xenomugil*, *Neomyxus*, *Chaenomugil*, and probably *Cestraeus*, with lower lips folded downward with highly specialized teeth and lips. The extreme specialization in this group may be considered the fresh-water genus *Cestraeus*. This genus has the teeth specialized into lamellae on the external surface of the lower jaw.

All fresh-water genera of mullets have ctenoid scales and all marine genera of mullets have cycloid scales except *Chaenomugil*, which has ctenoid scales.

#### Genus CESTRAEUS Valenciennes

*Cestraeus* VALENCIENNES, in Cuvier and Valenciennes, *Histoire naturelle des poissons*, vol. 11, p. 157, pl. 315, 1836 (genotype, *Cestraeus plicatilis* Valenciennes) (Celebes).

*Gonostomyxus* MACDONALD, *Proc. Zool. Soc. London*, 1869, No. 1, p. 39, pl. 1 (genotype, *Gonostomyxus loa-loa* MacDonald) (Rewa River, Na Vita Levu, Fiji Islands).

*Aeschrichthys* MACLEAY, *Proc. Linn. Soc. New South Wales*, vol. 8, p. 5, text figs., pl., 1883 (genotype, *Aeschrichthys goldiei* Macleay) (rivers of New Guinea).

The lips, teeth, preorbital bone, and jaws of the Mugilidae seem to have become differentiated more than other characters. This genus appears to have had its mouth structures more complicated and specialized than any other genus of mullets.

*Cestraeus* is characterized by the specialized lower jaw and by the thick lips on both jaws; the lower jaw is devoid of teeth; externally there occurs on each side of the mandible along the lateral edge a wide strip of transverse, very close-set, membranous lamellae; posteriorly the mandible ends in four bluntly rounded lobes, free posteriorly; the posterior end of the upper lip forms another pair of fleshy lobes; premaxillary with a row of setiform teeth, tips simple; tip of lower jaw without symphyseal knob; scales ctenoid; front edge of preorbital without concavity and scarcely or not serrated; maxillary and premaxillary not bent downward in line with front edge of preorbital, the former extending far behind the latter; nostrils in line with upper edge of orbit, close together, remote from groove behind upper lip; adipose eyelid absent; apparently no teeth on vomer, palatines or tongue; posterior edge of preorbital wide, serrated; margin of lower jaw acutely angular; gill membranes extending far forward not broadly joined across isthms.

The following collections were studied: U. S. N. M. No. 122819 from New Guinea; No. 137266 from Bouro Island, Dutch East Indies; and No. 137267 from the Philippines.

#### Genus JOTURUS Poey

*Joturus* POEY, *Memorias sobre la historia natural de la Isla de Cuba*, vol. 2, p. 263, pl. 18, figs. 4–5, 1860 (genotype, *Joturus pichardi* Poey) (Cuba).  
*Xenorhynchichthys* REGAN, *Ann. Mag. Nat. Hist.*, ser. 8, vol. 2, p. 461, 1908 (genotype, *Xenorhynchichthys stipes* (Jordan and Gilbert) = *Joturus stipes* Jordan and Gilbert) (Rfo Bayano near Panama).

I have examined the type of *Joturus stipes* Jordan and Gilbert (U. S. N. M. No. 31010 from Panama) and refer it to this genus.

This genus is characterized by the very thick lips in both jaws, devoid of teeth in the lips, and with the fleshy snout projecting beyond the lips so that the mouth is somewhat inferior in position, nearly horizontal; behind upper lip on upper jaw occurs a band of incisorlike multicuspid teeth, each side of lower jaw with a patch of similar multicuspid teeth widely separated at symphysis; no symphyseal knob on lower jaw; scales ctenoid; the front edge of the preorbital is nearly straight without concavity and not serrated; maxillary and premaxillary not bent downward posteriorly, but in line with front edge of preorbital; the nostrils are in line with upper edge of orbit, very close together, remote from front of snout; adipose eyelid absent; teeth present on vomer, palatines, and on tongue in small patches; posterior end of preorbital ending in a point ventrally; margin of



lower jaw rounded; gill membranes somewhat broadly attached across isthmus.

The following collections were studied: U. S. N. M. Nos. 45532 and 130878 from Mexico; Nos. 78887-9 from Panama; and No. 19915 from Central America.

#### Genus RHINOMUGIL Gill

*Rhinomugil* GILL, Proc. Acad. Nat. Sci. Philadelphia, 1863, p. 169 (genotype, *Mugil corsula* Hamilton-Buchanan) (rivers Ganges and Bengal).

*Squalomugil* OGILBY, Ann. Queensland Mus., pt. 1, pp. 3, 28, 1908 (genotype, *Mugil nasutus* de Vis) (coast of Queensland).

This genus is characterized by the thin lower lips, directed horizontally forward, not curved downward, and supplied with ciliform teeth embedded in the lip; upper lip with setiform teeth; tips of all teeth simple; tip of lower jaw with a symphyseal knob; scales ctenoid; front edge of preorbital nearly straight, without a conspicuous concavity and with but a few serrations; maxillary and premaxillary not strongly bent downward posteriorly but in line with front edge of preorbital; the nostrils are in line with the lower edge of the orbit, widely separated, and remote from tip of snout; adipose eyelid absent; vomer, palatines, and tongue probably toothless; posterior end of preorbital very narrow, ending in two or three spines; margin of lower jaw angular; gill membranes extending far forward, not joined across isthmus.

The diagnosis is based mostly on plate 9, figure 97, of Hamilton-Buchanan, and on Hora, Journ. Bombay Nat. Hist. Soc., vol. 40, No. 1, pp. 62-68, pl. and 3 text figs. of *Mugil corsula*, 1938; also on Whitley's (Australian Zool., vol. 10, No. 1, p. 22, fig. 16, 1941) account and description of *Mugil nasutus*, along with one specimen of *R. corsula*, U. S. N. M. No. 44767 from Rangoon.

#### Genus AGONOSTOMUS Bennett

*Agonostomus* BENNETT, Proc. Comin. Sci. Corresp. Zool. Soc. London, No. 14, p. 166, 1832 (genotype, *Agonostomus telfairii* Bennett) (Mauritius).

*Nestis* VALENCIENNES, in Cuvier and Valenciennes, Histoire naturelle des poissons, vol. 11, p. 167, pl. 317, 1836 (genotype, *Nestis cyprinoides* Valenciennes) (Île de France; Bourbon).

*Dajaus* VALENCIENNES, in Cuvier and Valenciennes, *ibid.*, p. 164, pl. 316 (genotype, *Dajaus monticola* Valenciennes = *Mugil monticola* Griffith) (rivers of Dominican Republic, Puerto Rico, and Jamaica).

*Neomugil* VAILLANT, Bull. Soc. Philom. Paris, ser. 3, vol. 6, p. 72, 1894 (genotype, *Mugil diguei* Vaillant = *Mugil monticola* Griffith) (Lower California).

*Agonostomus bryanti* Bean and Weed (U. S. N. M. No. 72582) belongs to the Eleotridae, and probably in the genus *Hypseleotris* Gill. It is not a mullet.

This genus is characterized by the thick lips in both jaws and by a wide band of small teeth in both jaws; the outer rows of the upper

jaw have simple tips, but the inner rows of teeth have bifid or trifid tips, at least in the adults; the teeth in the lower jaw usually have simple tips, but occasionally some have bifid tips; no symphyseal knob on lower jaw; scales ctenoid; front edge of preorbital, serrated but without conspicuous concavity, nearly straight; maxillary and premaxillary not bent downward posteriorly but mostly in line with front edge of preorbital; nostrils in line with upper edge of orbit, very close together, remote from groove behind upper lip; adipose eyelid absent; villiform teeth on vomer and palatines but apparently absent on tongue; posterior edge preorbital very wide; margin of lower jaw rounded; gill membranes extending far forward not broadly connected across isthmus.

The generic diagnosis is based on the description by Fontaine entitled, "*Sur La Chitte (*Agonostoma telfairii* Günther)*" in Bull. Soc. Zool. France, vol. 53, pp. 386–390, figs. 1–4, 1928, and on collections in the National Museum, too numerous to list the numbers here, but from Guadeloupe Islands, Secas Island, Mexico, Panama, Venezuela, and West Indies (largely from Old Providence Island, Jamaica, Cuba, Puerto Rico, and Haiti). There are a few specimens from New Zealand and New South Wales and one from the Hawaiian Islands.

#### Genus CHAENOMUGIL Gill

*Chaenomugil* GILL, Proc. Acad. Nat. Sci. Philadelphia, 1863, p. 169 (genotype, *Mugil proboscideus* Günther) (west coast of Central America).

This genus is characterized by the broad, thick, pliable lips bearing externally a band of small teeth with bifid tips in several close-set rows on both upper and lower jaws; lower lip directed downward and fitting snugly behind the upper lip when mouth is closed; tip of lower jaw more or less bluntly pointed but symphyseal knob undeveloped; scales ctenoid; front edge of preorbital flexible without concavity, serrated only posteriorly; maxillary and premaxillary not bent downward posteriorly; nostrils in line with upper edge of orbit, very close together, remote from groove behind broad upper lip; adipose eyelid absent; no teeth on vomer or palatines but some on tongue; posterior edge of preorbital wide, serrated; margin of lower jaw acutely angular; gill membranes extending far forward, not broadly connected across isthmus.

I have studied the following collections of *C. proboscideus*: U. S. N. M. Nos. 46563–4 and 125343 from Clarion Island; Nos. 54541, 56343, 67578, and 107050 from Socorro Island; No. 65449 from Chatham Island; No. 65448 from Culebra Island; No. 128504 from the Pearl Islands; No. 47471 from Mazatlán; No. 101645 from Cupica Bay, Colombia; and Nos. 79778–81, 79789, 79829, 79830, and 128571–2 from Panama. All records from the Pacific.

## Genus NEOMYXUS Steindachner

*Neomyxus* STEINDACHNER, Ichthyologische Beiträge (VII), Sitz. Akad. Wiss. Wien, vol. 78, p. 384, 1878 (genotype, *Myxus* (*Neomyxus*) *slateri* Steindachner) (Kingsmill and Sandwich Islands).

This genus is characterized by the thick pliable lips bearing externally two or three rows of characteristically shaped, 3-pointed or trifold setiform teeth on both jaws; lower lip with teeth and folded downward and fitting snugly behind the upper lip when mouth is closed; tip of lower jaw bluntly pointed with symphyseal knob small and located internally; scales cycloid; front edge of preorbital straight without concavity, serrated anteriorly; maxillary and premaxillary not bent downward posteriorly; nostrils in line with upper edge of orbit, moderately close together, the anterior nostril remote from groove behind upper lip; adipose eyelid absent; no teeth on vomer or palatines but probably some on the tongue; posterior edge of preorbital wide, and serrated; margin of lower jaw acutely angular; gill membranes extending far forward, not broadly connected across the isthmus.

I have studied the following collections in the United States National Museum: Niuaufu Island, U. S. N. M. Nos. 91854-6, 91858-9, and 91983; Phoenix Islands, Nos. 115629 and 115632; Swains Island, Nos. 115627-8 and 115631; Wake Island, No. 82893; Makemo Island, No. 65969; Baker Island, No. 88153; Guam Island, No. 65968; Ellis Island, No. 65967; Tongareva Island, No. 88152; Manga Riva Island, No. 65596; Marquesas Islands, Nos. 89744-5; Hawaiian Islands, Nos. 52772, 55433, 55434, 55439, 55475, 55488, 55525, 82867, 89532, 115630, and 126540. These specimens all came from the central tropical Pacific Ocean or Oceania.

## XENOMUGIL, new genus

*Genotype*.—*Mugil thoburni* Jordan and Starks, in Jordan and Evermann, U. S. Nat. Mus. Bull. 47, pt. 1, p. 812, 1896 (types, U. S. N. M. No. 47576, Galápagos Islands).

This genus is characterized by thick lips in both jaws, each bearing, externally, a uniserial row or in two rows anteriorly of setiform teeth with unbranched tips; lower lip folded downward and fitting snugly behind the upper lip when mouth is closed, tip of lower jaw bluntly pointed, with a small symphyseal knob somewhat developed behind tip of jaw; scales cycloid; front edge of preorbital straight without concavity and serrated; maxillary and premaxillary not bent downward posteriorly; nostrils in line with upper edge of orbit widely separated, the anterior one as close to groove behind upper lip as to posterior nostril; adipose eyelid present, well developed on adult; no teeth on vomer or palatines but probably a few on the tongue; pos-

terior edge of preorbital rather narrow, serrated; margin of lower jaw acutely angular; gill membranes extending far forward not broadly connected across the isthmus.

I have examined the following collections, all taken from the Galápagos Islands: U. S. N. M. Nos. 41381, 41459, 50017, 65597, 89748. The two types bear U. S. N. M. No. 47576.

This new genus may be distinguished from all other genera in the family Mugilidae by the key on pages 379 to 381.

Named *Xenomugil* in reference to the "strange" teeth and lips.

#### CRENIMUGIL, new genus

*Genotype*.—*Mugil crenilabis* Förskal.

Under *Chelon*, Oshima (Ann. Carnegie Mus., vol. 13, p. 257, pl. 13, fig. 1, 1922) lists a single species, "*Chelon crenilabis* (Förskal)," from the Pescadores Islands, west of Formosa, but since this species belongs in a genus distinct from *Chelon* Röse, with *Mugil chelo* as the type, it appears necessary to propose a new generic name for this type of mullet. It is diagnosed below.

This genus is characterized by the thick lips bearing papillae externally and internally; those forming the row along the external edge of the lips are crenulate, becoming more so in the adults and even continuous around the corners of the mouth; the thick lower lip is somewhat folded outward; the papillae apparently represent "teeth"; inside of upper jaw near front of mouth are plicate fleshy folds; symphyseal knob at tip of lower jaw; scales cycloid; front edge of preorbital with concave notch to receive corner of mouth; maxillary and premaxillary moderately bent downward, but the maxillary not exposed as in *Chelon*; nostrils on level of upper edge of orbit, moderately separated, so that the anterior nostril is as close to groove behind upper lip as to posterior nostril, the anterior nostril being rather close to the groove; no adipose eyelid; no teeth on vomer but teeth on palatines and a few on tongue; posterior edge of preorbital very wide, wider than space between nostrils; margin of lower jaw broadly angular; gill membranes extending far forward, not broadly connected across the isthmus.

I have examined the following collections bearing U. S. N. M. numbers: Indian Ocean, Nos. 44522 and 44557; Christmas Island, No. 19248; Phoenix Islands, Nos. 115640-2; Samoan Islands, No. 115639; Tahiti, No. 87649; Marshall Islands, No. 65912; Guam, No. 65913.

This new genus may be distinguished from all other genera in the family Mugilidae by the key on pages 379 to 381.

Named *Crenimugil* in reference to the crenulate lips.

## Genus MUGIL Linnaeus

FIGURE 28, a-c

*Mugil* LINNAEUS, *Systema naturae*, ed. 10, vol. 1, p. 316, 1758 (genotype, *Mugil cephalus* Linnaeus) (European Ocean).

*Cephalus* LACEPÉDE, *Histoire naturelle des poissons*, vol. 2, p. 589, 1800, new name on Plumier MS. (genotype, *Mugil cephalus* Linnaeus).

*Arnion* GISTEL, *Naturgeschichte des Thierreichs*, p. x, 1848, substitute name for *Mugil* (genotype, *Mugil cephalus* Linnaeus).

*Ello* GISTEL, *Handbuch der Naturgeschichte für alle Stände*, p. 356, 1850 [= 1847], and *Naturgeschichte des Thierreichs*, p. 109, 1848; according to Whitley, *Austral. Zool.*, vol. 6, pt. 3, p. 251, 1930, a synonym of *Mugil* Linnaeus.

*Querimana* JORDAN and GILBERT, *Proc. U. S. Nat. Mus.*, vol. 5, p. 588, 1883 (genotype, *Myxus harengus* Günther) (Pacific coast of Central America).

The diagnosis of *Mugil* is based on descriptions by Cuvier and Valenciennes (*Histoire naturelle des poissons*, vol. 11, p. 19, pl. 307, 1836, Mediterranean Sea) and Günther (*Catalogue of the fishes in the British Museum*, vol. 3, p. 417, 1861, Mediterranean Sea), on

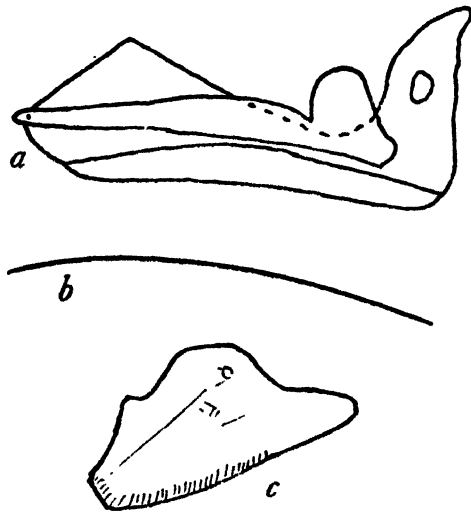


FIGURE 28.—Sketch of the maxillary, premaxillary, and preorbital bones of *Mugil cephalus* (U. S. N. M. No. 45009 from Greece): a, Maxillary lying over premaxillary; b, view of ventral contour of maxillary; c, preorbital.

U.S.N.M. Nos. 45009 and 84585 from the Mediterranean Sea, and on numerous other specimens referable to one or more species from many localities throughout the seas of the world.

I have examined the five types of *Mugil cetosus* Gilbert (U.S.N.M. Nos. 46554 and 48254) and a paratype (No. 124990) from Clarion Island and refer them to this genus. Eight small types of *Querimana gyrans* Jordan and Gilbert (U.S.N.M. No. 34966) belong to this genus.

This genus is characterized by a thin-edged lower lip projecting forward horizontally, not curved or folded downward; the teeth in the lower lip are setiform or ciliform, partly embedded or conspicuous; teeth in upper lip similar. The outer row of teeth in both lips is usually more prominent, with simple tips, and if inner rows occur these are either bifid or trifold, at least on adults (apparently the teeth in certain species of this genus become bifid or even trifold in large adults); a symphyseal knob present at tip of lower jaw; scales cycloid; the preorbital has the front edge straight or nearly so without a conspicuous concavity; maxillary and premaxillary not bent downward posteriorly, but in line with the front edge of preorbital; nostrils in line with the upper edge of the orbit, widely spaced, the anterior is closer to groove behind upper lip than to posterior nostril; adipose eyelid present; upper lip usually not so wide as distance between nostrils; teeth probably absent on vomer, palatines, and tongue; posterior edge of preorbital narrower than space between nostrils; margin of lower jaw angular; gill membranes extending far forward, not broadly connected across isthmus.

In this genus I find that in small specimens of certain species the teeth have simple tips, but later the inner teeth have bifid tips and in the largest adults some possess trifold tips. The teeth of the outer row usually have simple tips, but in some large specimens these are bifid too.

I have examined too many collections of the numerous species referable to this genus to list them here. The localities represented are: Europe, both coasts of Africa, both coasts of North and South America, West Indies, Hawaiian Islands, Australia, Oceania, Japan, coast of Asia, in temperate and tropical seas.

#### Genus MYXUS Günther

##### FIGURE 29, a-c

*Myxus* GÜNTHER, Catalogue of the fishes in the British Museum, vol. 3, pp. 409, 466, 1861 (genotype, *Mugil elongatus* Günther) (Hobsons Bay and Port Jackson, Australia).

This genus is characterized by a moderately thin lower lip projecting horizontally forward, with a single row of small, close-set, incisorlike teeth rather firmly set; teeth in upper jaw similar and in one row; all teeth with simple tips; no inner rows of teeth in either jaw; a symphyseal knob at inside tip of lower jaw; scales cycloid; front edge of preorbital straight, no concave notch; maxillary and premaxillary not bent downward but nearly straight, in line with front edge of preorbital; maxillary not exposed posteriorly; nostrils on level of upper edge of orbit rather close together, the anterior much farther from groove behind upper lip than from posterior nostril; no adipose eyelid; narrow band of teeth on vomer and palatines, and probably on tongue;

posterior edge of preorbital very wide, much wider than space between nostrils; margin of lower jaw rounded; gill membranes extending far forward, not broadly connected across isthmus.

The diagnosis of this genus was based on *M. elongatus*, U. S. N. M. Nos. 47770 and 47773 from Lord Howe Island and Nos. 59889, 59913, and 83052 from New South Wales.

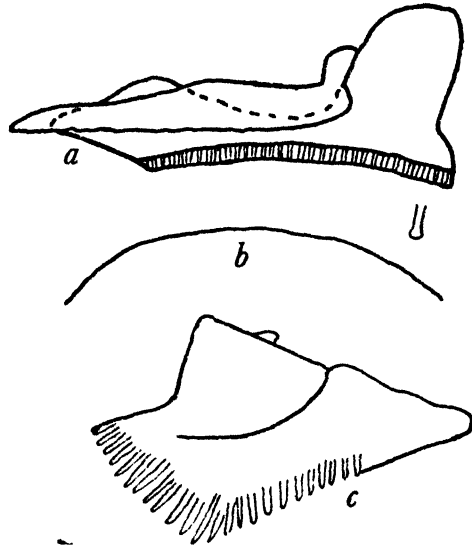


FIGURE 29.—Sketches of the maxillary, premaxillary, and preorbital bones of *Myxus elongatus* (U. S. N. M. No. 59912 from New South Wales): *a*, Maxillary lying over premaxillary (a tooth is shown below at right hand side); *b*, view of ventral contour of maxillary; *c*, preorbital.

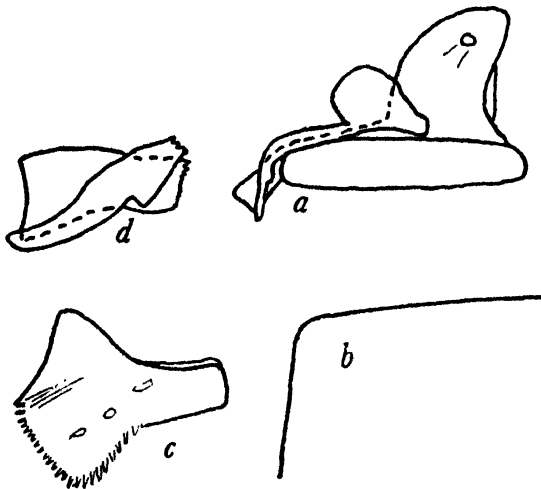


FIGURE 30.—Sketches of the maxillary, premaxillary, and preorbital bones of *Chelon chelo* (U. S. N. M. No. 123002 from Europe): *a*, Maxillary lying over premaxillary; *b*, view of ventral contour of maxillary; *c*, preorbital; *d*, posterior tips of maxillary and premaxillary.

Genus *CHELON* Röse

FIGURE 30, a-d

*Chelon* RÖSE, Petri Artedi Angermania—Succi<sup>3</sup> synonymia nominum piscium . . . , ed. 2, p. 118, 1793.—JORDAN and EVERMANN, Genera of fishes, pt. 1, p. 52, 1917 (genotype, *Mugil chelo* Cuvier and Valenciennes).

*Liza* JORDAN and SWAIN, Proc. U. S. Nat. Mus., vol. 7, pp. 261, 262, 1884 (genotype, *Mugil capito* Cuvier) (Mediterranean and seas of Europe).

*Oedalechilus* FOWLER, Proc. Acad. Nat. Sci. Philadelphia, vol. 55, p. 748, 1903 (genotype, *Mugil labeo* Cuvier) (Mediterranean Sea).

*Ellochelon* WHITLEY, Australian Zool., vol. 6, pt. 3, p. 251, 1930 (genotype, *Mugil vaigiensis* Quoy and Gaimard) (Waigion).

The genus *Oedalechilus* Fowler, with *Mugil labeo* Cuvier as its type, appears to represent the most extreme development of the mouth of the genus *Chelon*. In *M. labeo* the upper lip is nearly as broad as the orbit and the maxillary bone extends vertically downward below the preorbital bone where its posterior end is exposed. There are other species from the Mediterranean in which the upper lip is not so broad and the mouth is more horizontal with the maxillary similarly exposed.

*Chelon* Röse (loc. cit.) was listed by Jordan and Evermann (loc. cit.) as a valid genus, with "*Chelon* of Gesner, which is probably *Mugil chelo* Cuvier and Valenciennes" as its type. Although the generic name is given as *Chelon* by Röse, no species are listed in the binomial sense, and no description of any kind is given, yet the genera listed in the 1793 edition are definitely used in the binary sense, including *Chelon*. Common names of pre-Linnacan authors with references are cited in the synonymy, as for example: "Labeo. Gaz. Arist. l. c." and "chelo. Rondel. l. 9 c. 5, p. 266. gesner. p. 552." The mullet "*Chelo*" or "*Chelon*" of the Mediterranean Sea is such a well-known species that Günther (Catalogue of the fishes in the British Museum, vol. 3, p. 454, 1861) in the synonymy under *Mugil chelo* lists without question the common name "*Chelon*" as used by "Rondel.," "Gesner.," "Willughby.," and "Ray" but does not mention Röse. The first description and binomial use of *Mugil chelo* appears to be that by Cuvier (in his Règne Animal).

Oshima (Ann. Carnegie Mus., vol. 13, pp. 241, 257, pl. 13, fig. 1, 1922) has recognized the genus *Chelon* Röse, 1793, listing but one species, *Chelon crenilabis* (Forsk.) under the genus, but this species has most elaborately developed papillate lips and otherwise is not a *Chelon* but belongs in a new genus herein proposed on page 387.

I have examined the small type of *Agonostomus dorsalis* Streets from the Samoan Islands (U. S. N. M. No. 15111) and refer it to this genus. Two paratypes of *Mugil canaliculatus* J. L. B. Smith (U. S. N. M. No. 93647) from Durban, South Africa, also belong to this genus.



The genus *Chelon* Röse is characterized by the thin-edged lower lip projecting forward horizontally, not curved or folded downward; the lower lip is made up of ciliform teeth embedded in the lip, none of which project beyond the flesh of the lip; in the upper lip the setiform teeth project beyond the lip; tips of all teeth simple, none bifid or trid even in large adults; behind outer row of setiform teeth in upper lip occur minute teeth in one or more rows, all with simple tips; a symphyseal knob at tip of lower jaw; scales cycloid; the pre-orbital has a concave notch or shallow concavity in its front margin to accommodate the exposed maxillary, which is hooked or bent downward; the premaxillary is also bent posteriorly at a more or less sharp angle, the posterior part of this bone lying behind the maxillary; the nostrils are on the level of the upper edge of the orbit and are close together, usually closer to each other than anterior is from groove behind upper lip; no adipose eyelid present; upper lip wider than distance between nostrils; teeth on vomer, palatines, and tongue present or absent; the posterior edge of the preorbital is wider than the space between the nostrils; margin of lower jaw angular; gill membranes extending far forward, not broadly connected across isthmus.

The collections referred to this genus are too numerous in the National Museum to list here, but they came from the following localities in the Pacific: Marquesas Islands, Phoenix Islands, New Hebrides, Sumatra, Java, Roual, Samoan Islands, Tahiti, New Guinea, Christmas Island, Marshall Islands, Solomon Islands, Celebes, and Philippine Islands, China coast, Japan, Korea, Peter the Great Bay, and New South Wales, Australia. In the Atlantic: Europe, British Isles, Norway, Azores, and Canary Islands. Other localities: Mediterranean Sea, Island of Mauritius, Burma and India, British East Africa, British South Africa, and French Congo, Africa.

I did not find any specimen from the New World that was referable to this apparently Old World genus.

#### Genus *TRACHYSTOMA* Ogilby

FIGURE 31, a-c

*Trachystoma* OGILBY, Proc. Zool. Soc. London, 1887, p. 614 (genotype, *Trachystoma multident* Ogilby) (Port Stevens at mouth of Keruah River) (= *Mugil breviceps* Steindachner = *Mugil pelardi* Castelnau).

*Sicamugil* FOWLER, Not. Nat., No. 17, p. 9, fig. 1, 1939 (genotype, *Mugil hamiltoni* Day) (fresh waters of Burma).

*Gracilimugil* WHITLEY, Australian Zool., vol. 10, pt. 1, p. 19, fig. 14, 1941 (genotype, *Gracilimugil ramsayi* (Macleay) = *Mugil ramsayi* Macleay, 1883) (Burdekin River, Queensland).

Although I have not seen a specimen of *Gracilimugil ramsayi* (Macleay) I am unable to find any statement in Whitley's diagnosis that definitely separates it from *Trachystoma*.

This genus is characterized by having ciliform teeth embedded in the lips of both jaws, their tips not or scarcely visible; the lower lip is thin as in *Chelon* and directed forward horizontally; tip of lower jaw with symphyseal knob; scales ctenoid; front edge of preorbital nearly straight, without conspicuous concave notch, and its posterior edge with or without greatly enlarged spines; maxillary and premaxillary not bent downward but extending in nearly same line as front edge of preorbital except when the spines project as in *hamiltoni* Day; nostrils in line with upper edge of orbit, somewhat separated, closer together than anterior is from edge of groove behind upper lip or as far apart as anterior is from edge of groove behind upper lip; adipose eyelid wholly absent; a narrow band of teeth on vomer and palatines and

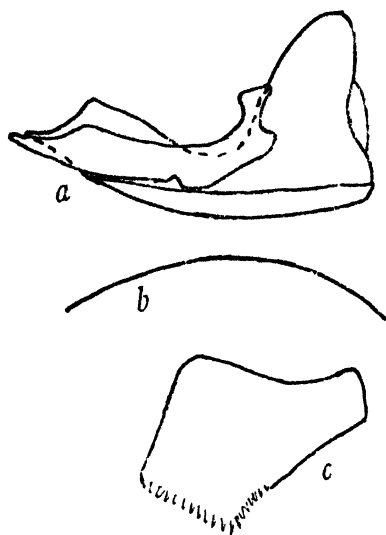


FIGURE 31 —Sketches of the maxillary, premaxillary, and preorbital bones of *Trachystoma petardi* (U. S. N. M. No. 59866 from New South Wales): a, Maxillary lying over premaxillary; b, view of ventral contour of maxillary; c, preorbital.

probably on tongue; margin of lower jaw rounded to somewhat angular; gill membranes extending far forward, not broadly connected across isthmus; anal origin notably in front of second dorsal origin.

The generic diagnosis was based on three specimens of *Trachystoma petardi* (U. S. N. M. No. 59866) from Clarence River, New South Wales. Also I refer to this genus a specimen from Durban, South Africa, sent to the National Museum many years ago under the name "*Mugil euronotus*" by the Albany Museum. This specimen agrees with Dr. J. L. B. Smith's description (Ann. South African Mus., vol. 30, pp. 610, 613, fig. 7, pl. 16, E, 1935), which states that it occurs almost wholly in fresh water and only rarely in the sea. I have studied a small specimen of *Mugil hamiltoni* Day (U. S. N. M. No.

44795) from Rangoon that I refer to this genus. From *petardi* it differs in the greater development of the preorbital spines.

**HETEROMUGIL, new genus**

*Genotype*.—*Mugil tricuspidens* J. L. B. Smith.

This new genus of Mugilidae is a *Chelon* with trifid and rarely bifid teeth in the upper lip in a single row, as observed on specimens 60 mm. and longer. These teeth are setiform, incisorlike, and close-set. The lower lip is moderately thin with embedded ciliform teeth. It has the maxillary exposed beyond and below the preorbital; the premaxillary is sharply angular, extending behind the maxillary bone which turns downward; the upper lip is thick and wide, wider than the distance between nostrils; the posterior edge of the preorbital is wider than the space between nostrils, and the anterior nostril is much closer to the posterior one than to the groove separating upper lip and snout; no adipose eyelid is developed; there are patches of villiform teeth on the pterygoids, vomer, and tongue; other characters are those of the genotype *Mugil tricuspidens*.

This new genus differs from all other genera of Mugilidae as distinguished in the key, pages 379 to 381.

I have examined one specimen, a paratype of *Mugil tricuspidens* J. L. B. Smith (U. S. N. M. No. 93651) from Mazeppa Bay, South Africa. Specimens shorter than 60 mm. have not been collected according to Dr. J. L. B. Smith.

Named *Heteromugil* in reference to the distinguishing (i. e., different) teeth, with trifid or bifid tips.

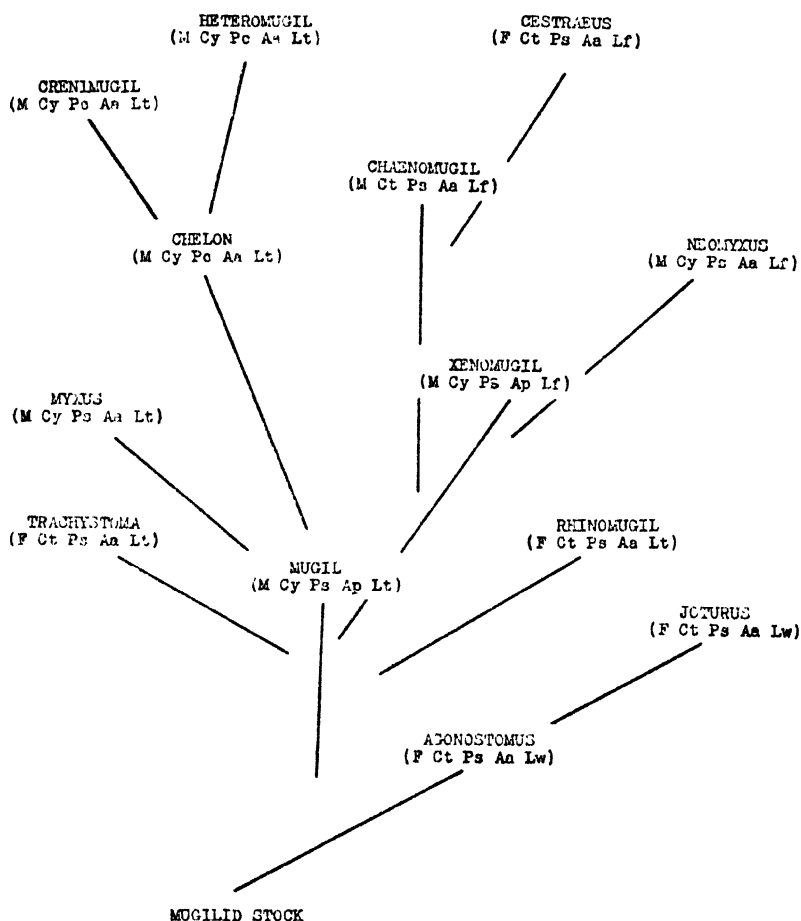


FIGURE 32.—Diagram of the possible relationships of genera of the Mugilidae. Letters in the parentheses under each genus indicate some of the characters used in forming an opinion as to the general evolutionary trends. (Aa.—Adipose eyelid absent; Ap.—Adipose eyelid present; Ct.—Ctenoid scales; Cy.—Cycloid scales; F.—Fresh-water habitat; Lf.—Lower lip folded downward; Lt.—Lower lip with thin edge projecting forward; Lw.—Lower lip thickish; M.—Marine habitat and entering brackish waters; Pc.—Front edge of preorbital straight and the maxillary and premaxillary extending in the same general line as front edge of preorbital; Ps.—Front edge of preorbital concave or deeply notched, the maxillary and premaxillary bent at an abrupt angle posteriorly, and exposed below preorbital.)





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## THE PHORID FLIES OF GUAM

By G. E. BOHART

THE primary purpose of this paper is to make available the names of several species of Phoridae (Diptera) whose biology and life history will be discussed in a paper (to be published by the Navy) on the filth-inhabiting flies of Guam. In it will appear biological notes and descriptions and illustrations of the early stages of many of the phorids herein described.

Except for those species reared from filthy environments no particular effort was made to collect phorids. Consequently, several of the species described are represented by unique specimens, and it may be inferred that numerous species remain to be discovered on the island. Because of the paucity of material I felt it advisable to illustrate the species as fully as possible, so that if some of these described as new prove to be already named, or if the discovery of many more species reduces the value of the key, the figures will still prove useful. In most cases, in view of the full illustrations, descriptions have been kept at a minimum size.

The field work in connection with this study was done on Guam at the field laboratories of Naval Medical Research Unit No. 2 under the direction of Commodore Thomas J. Rivers. The taxonomic work and the preparation of the paper were done at the U. S. National Museum under the auspices of the Research Division of the Bureau of Medicine and Surgery. I am much indebted to Lt. (jg) J. L. Gressitt, who worked with me on Guam, for some of the rearing and collecting of specimens and for carrying on the work after I left the island. The men at the National Museum have done their usual utmost to provide facilities and assist me whenever necessary.

Phorids, in relation to the insect fauna as a whole, are prominent on Guam both as to species and individuals. The cosmopolitan *Megaselia scalaris* (Loew) was abundant in all inhabited areas and bred freely in such diverse materials as green cornstalks, rotting coconuts, carrion, and human excrement. It was almost impossible to keep it from contaminating our cultures of other flies, and it bred freely in fresh stools under examination for intestinal parasites by the parasitology laboratory. The highly degenerate *Chonocephalus subglaber* had the habit of swarming on decaying fruit by thousands, and it could nearly always be taken in decaying wood. Collections of rotting shells buried just beneath the ground surface furnished breeding material for six species of phorids, including two of the wingless genus *Puliciphora*.

The figures are from drawings by the author. For subjects I used specimens in dilute alcohol after softening (but not decolorizing) in KOH. The genitalia were drawn from dissected specimens in alcohol and checked again for accuracy of details with the same specimens mounted in euparal.

The holotypes and allotypes of the new species are in the collection of the U. S. National Museum. Paratypes will be deposited in the California Academy of Sciences, the collection of the Hawaiian Sugar Planters' Association, and the author's collection.

#### Genus MEGASELIA Rondani

##### MEGASELIA (MEGASELIA) SETIFEMUR, new species

#### FIGURE 38

*Holotype*, male.—Length 1.2 mm.; length of wing 1 mm.; frons, dorsum of thorax, abdomen, and halteres uniformly piceous-brown; pleura, venter of abdomen, and legs pale testaceous except for darker apices of hind femora. *Head*: Frontal bristles thick but not long (not more than two-thirds as long as width of frons); antiales and lower frontals close together and both lower than upper supra-antennals, which are about twice as long and far apart as the lower supra-antennals; cheeks with two strong bristles at lower angle and two moderate ones at level of antennal insertion; frontal hair rather sparse and long. *Thorax*: Dorsal hairs short but strong, becoming sparse and bristly toward scutellum; posterior edge of scutum with four bristles, the outer ones about one-half longer than the inner; scutellum with a strong inner, apical pair of bristles about as strong as the outer scutal ones, and a very weak outer basal pair less than half as long as the inner ones; pleura bare except for three bristles on ventral margin of propleuron; anterior spiracles included in separate sclerites. *Legs*: Of moderate length, the posterior tibiae and tarsi about as long as wings; posterior tibiae with a single dorsal row of setae inside the dorsal hair fringe; posterior metatarsi with two inner bristles some-

what longer than the others along the same row; ventral margin of posterior femora with about four basal hairs, much longer than any toward the apex. *Wings*: Membrane lightly infuscated, costal bristles long and sparse; wings otherwise bare except for a few bristles basally on posterior margin; veins placed as shown in figure 38. *Abdomen*: Tergites almost uniformly brown, slightly paler basally and medially and very sparsely pubescent, the hairs mostly in patches laterally and along posterior margins; genitalia small, the apical lamella divided into two parts, the upper part with scattered hairs as long as the pair of terminal bristles on the lower part.

*Holotype* (unique) (U. S. N. M. No. 57990): Pago River Valley, Guam, June 1945, swept from dense jungle vegetation on a steep slope (G. E. Bohart).

*Remarks*.—This species is similar in coloration and costal fringe of the wing to *parabasiseta* but lacks mesopleural bristles and any bristles on the third longitudinal vein. It runs close to *equiseta* Brues and *unisetosa* Brues in his key to the Philippine species (1936) but differs from the former in having lighter color, longer and sparser costal wing fringe, and shorter frontal bristles. It differs from *unisetosa* in lacking a bristle on the base of the radial sector vein and having four bristles on the posterior scutal margin. It runs to couplet 55 in Malloch's key to the *Megaselia* in the U. S. National Museum (1912) but differs from either *conspicualis* Malloch or *inornata* Malloch by having a normal costa and brown halteres. The male genitalia and basal ventral hairs of the hind femora will probably serve to characterize this species.

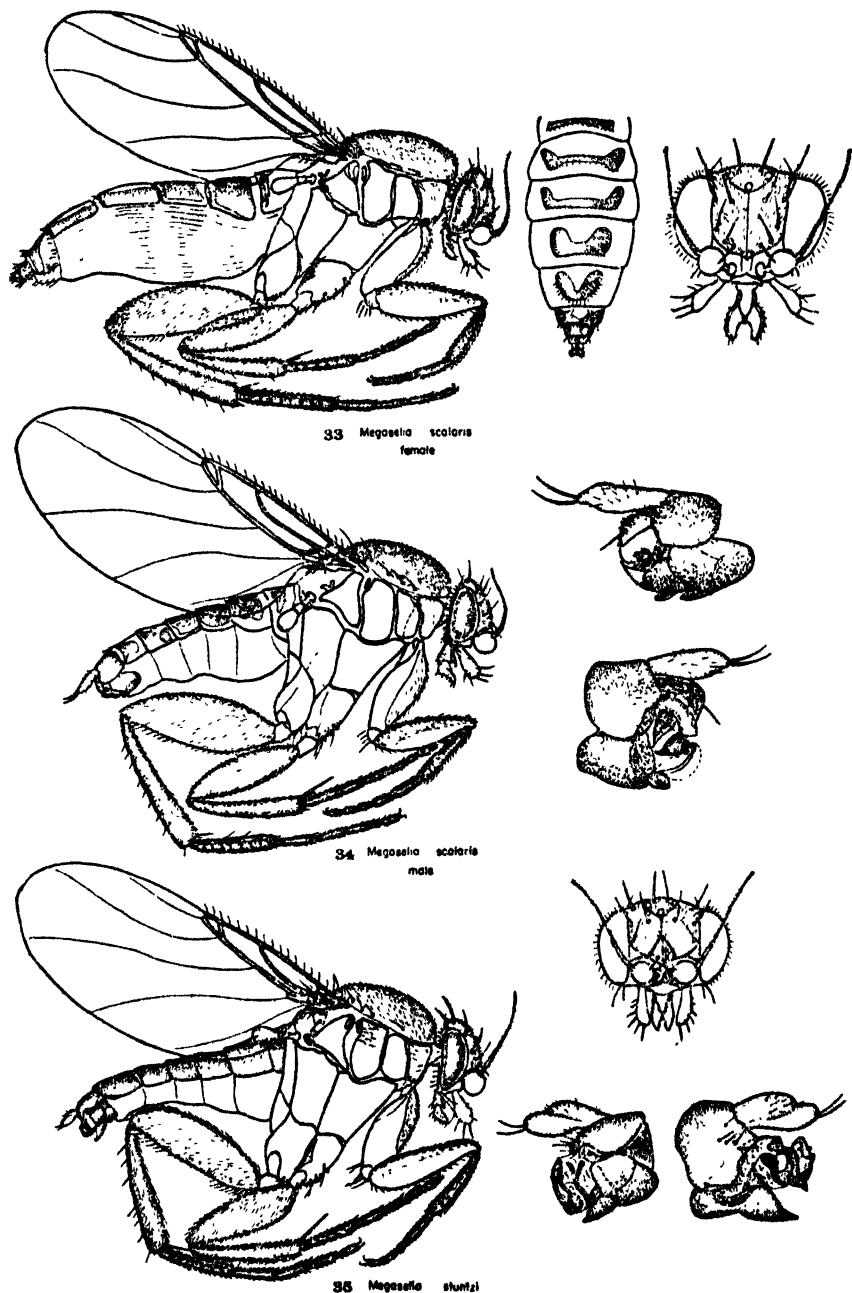
MEGASELIA SUIIS, new species

FIGURE 36

*Holotype*, male.—Length 1.5 mm.; length of wing 1.4 mm.; body yellow; frons somewhat darkened above; scutum testaceous; abdomen yellow, with fourth tergite dark except ventrally, second and third tergites dark apically and laterally; genitalia dark basally; hind femora strongly darkened apically; wings almost hyaline. *Head*: Frontal bristles exceptionally long and slender; antiales as close to supra-antennals as to lower frontals; inner supra-antennals only half as long as outer; antennal arista no longer than head height; palpi with weak bristles basally in addition to four outwardly directed apical or subapical ones and an inwardly directed one; genal angles with two strong bristles. *Thorax*: Dorsal pubescence short and close, becoming bristly posteriorly; posterior scutal margin with a pair of inner bristles over half as long as the usual outer ones; bristles along outer margin of scutum as long as free end of  $R_{1+2}$ ; scutellum with a pair of long posterior bristles and a pair of very reduced hairlike ones

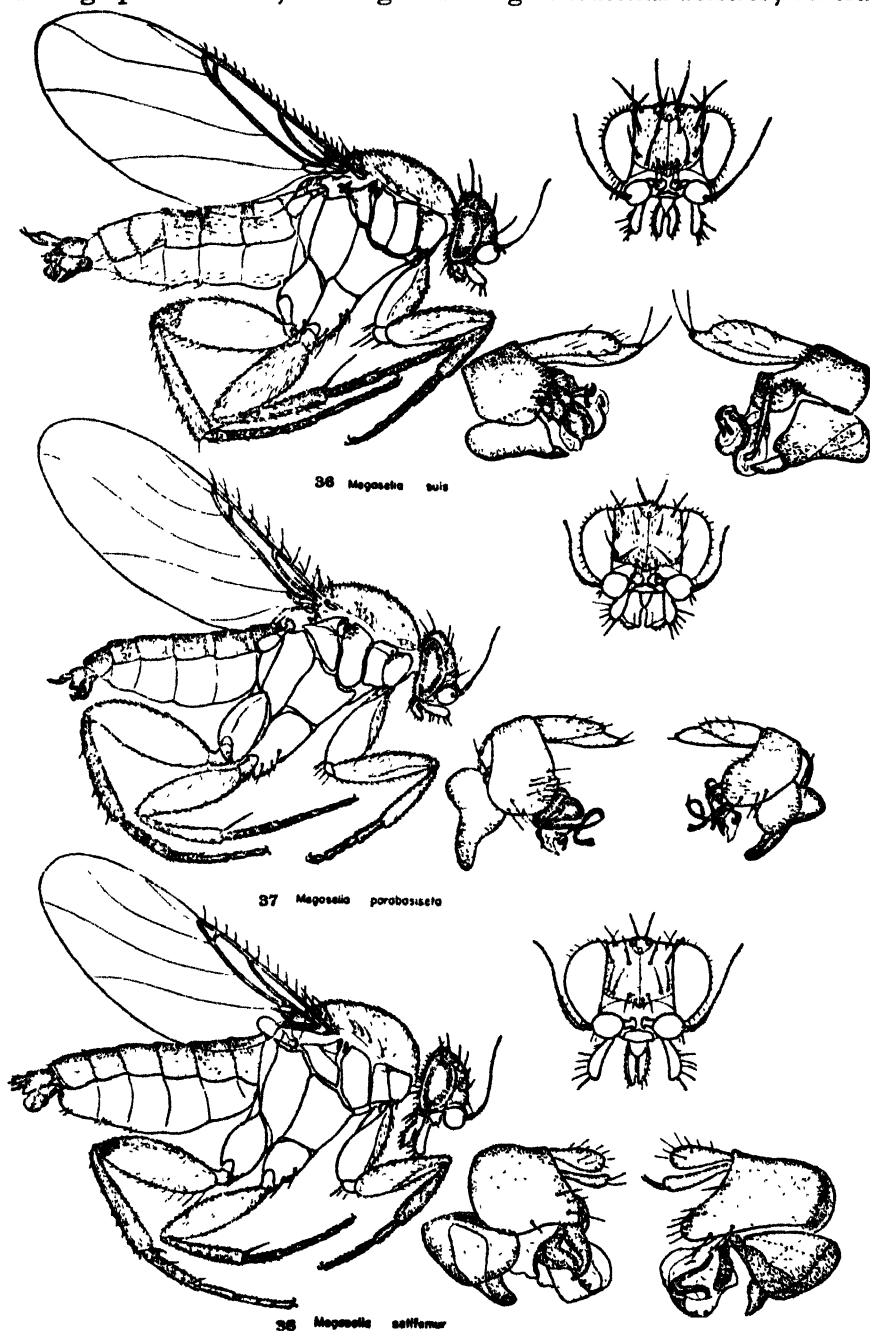


anteriorly; pleura bare except for four ventral bristles and a postero-dorsal patch of pubescence on the propleura. *Legs*: Hind tibiae and tarsi together a little longer than wings and with relative lengths of



FIGURES 33-35.—Phoridae of Guam: 33, Female of *Megasetia scalaris* (Loew); 34, male of *Megasetia scalaris*; 35, *Megasetia stuntzi*, new species,

2:3:5; hind tibiae with a single dorsal row of 11 setae along their inner sides; midtibiae with a weak dorsal row of setae; fore coxae with three strong apical bristles, the longest as long as scutellar bristles; ventral



FIGURES 36-38.—Phoridae of Guam: 36, *Megaelia ruis*, new species; 37, *Megaelia parabasista*, new species; 38, *Megaelia setifemur*, new species.

margins of hind femora with hairs of apical third longer than elsewhere. *Wings*: About two-fifths as broad as long; setae along costa moderately long, becoming more upright beyond point midway from humeral cross vein to apex of  $R_1$ ; costa nearly two-thirds as long as wings; placement of veins as shown in figure 36; second vein without setae basally. *Abdomen*: Lateral areas of first tergite rather closely covered with minute hairs; tergites 3 to 5 each with lateral patches of a few small hairs; sides of tergites 5 and 6 uniformly haired, with distinct apical fringe, especially on tergite 6; sternites 3 to 6 ventrally with rather numerous setae or coarse hairs; genitalia of moderate size, the lamella large, creamy in color, with terminal bristles long and delicate.

Holotype (U. S. N. M. No. 57991) and three paratype males: Agana, Guam, June 1945, reared from fresh pig dung (G. E. Bohart). One paratype male: Pago River, Guam, June 1945, swept from dense foliage near a garbage dump (G. E. Bohart).

*Remarks*.—On Guam this species resembles only *scalaris* Loew in general appearance but can be separated by its greater extent of yellow on the abdomen, more confined propleural pubescence, and more delicate terminal bristles on the genitalia. It is close to *scutleri* Brues from the Philippines (Brues, 1936) but has longer costal setae, darker palpi and legs (grayish instead of whitish), and weaker supra-antennal bristles. It runs close to *safunae* Malloch from Samoa (Malloch, 1935) but differs by having yellow frons and antennae and more yellow on the abdomen. In Malloch's key to North American species (1912) it runs to *subflava* but has narrower costal cells, more bristles on the propleura, and weaker hairs on the sides of second abdominal tergite. It is much larger than *bisecta* Brues to which it runs in Brues's key, is a deeper yellow and has a longer costa.

MEGASELIA STUNTZI, new species

FIGURE 35

*Holotype*, male.—Length 1.7 mm.; length of wing 1.4 mm.; body dark brown above, brown laterally and ventrally, without yellow or creamy areas; hind femora apically darkened. *Head*: Frontal bristles relatively short but very thick and arranged as in figure 35; lower margin of head, seen from the side, with six bristles. *Thorax*: Dorsal pubescence short and close; lateral margin of mesonotum with four stout bristles before the wing base; propleura with about 12 scattered small hairs in the upper posterior third and two small bristles at the ventral corners; posterodorsal portion of mesopleura with a patch of about 12 short hairs a little stronger than propleural ones; scutellum with two pairs of strong subequal bristles; posterior scutal margin with two pairs of bristles, the inner nearly as long as the outer. *Legs*:

Hind tibiae and tarsi together distinctly longer than wings; inner posterior margins of hind tibiae with eight bristles; hind femora with basal ventral bristles longer than apical ventral ones; mid coxae with three strong bristles. *Wings*: Slightly yellowish, with costal fringe and placement of veins as shown in figure 35; second vein without setae. *Abdomen*: Uniformly blackish brown; segments nearly bare except for apical fringes and for small lateral patches on first two segments; sternal hairs small and few; genitalia small, with a short lamella, bearing slender lamellar bristles; genitalic details as in figure 35.

Holotype (U. S. N. M. No. 57992) and one paratype male: Point Oca, Guam, June 21, 1945, reared from dead mollusks (G. E. Bohart and J. R. Stuntz).

*Remarks*.—This species resembles *setifemur* but is larger and has mesopleural vestiture. It also resembles *parabasiseta* but has no dominant mesopleural bristle and has a much shorter costal wing fringe. In Malloch's key to the Phoridae of Samoa (1935) it runs to *M. pacifica* but has the first longitudinal vein ending closer to the second than to the humeral cross-vein.

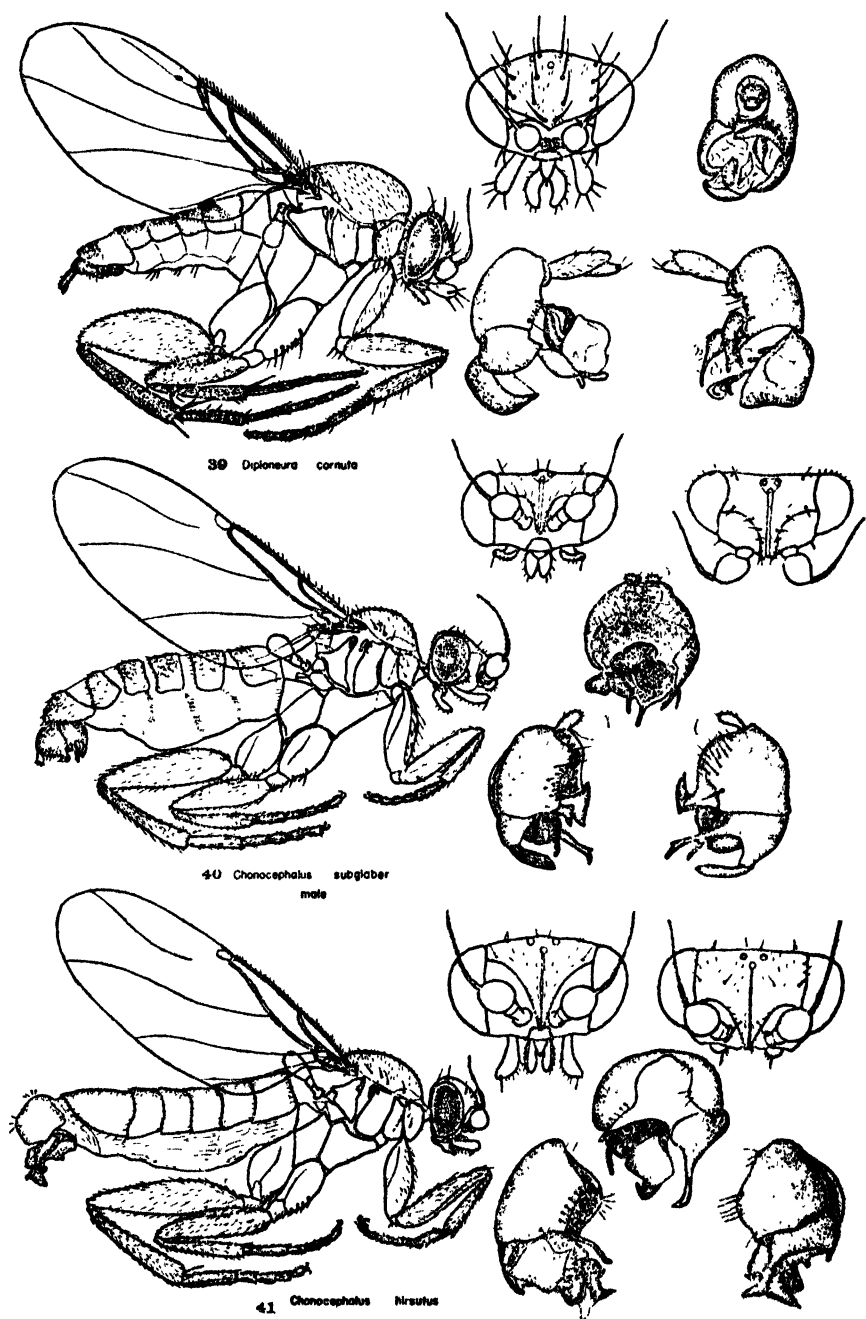
The fly is named for J. R. Stuntz, who did much of the rearing work on Guam for our studies on filth-inhabiting flies.

MEGASELIA PARABASISETA, new species

FIGURE 37

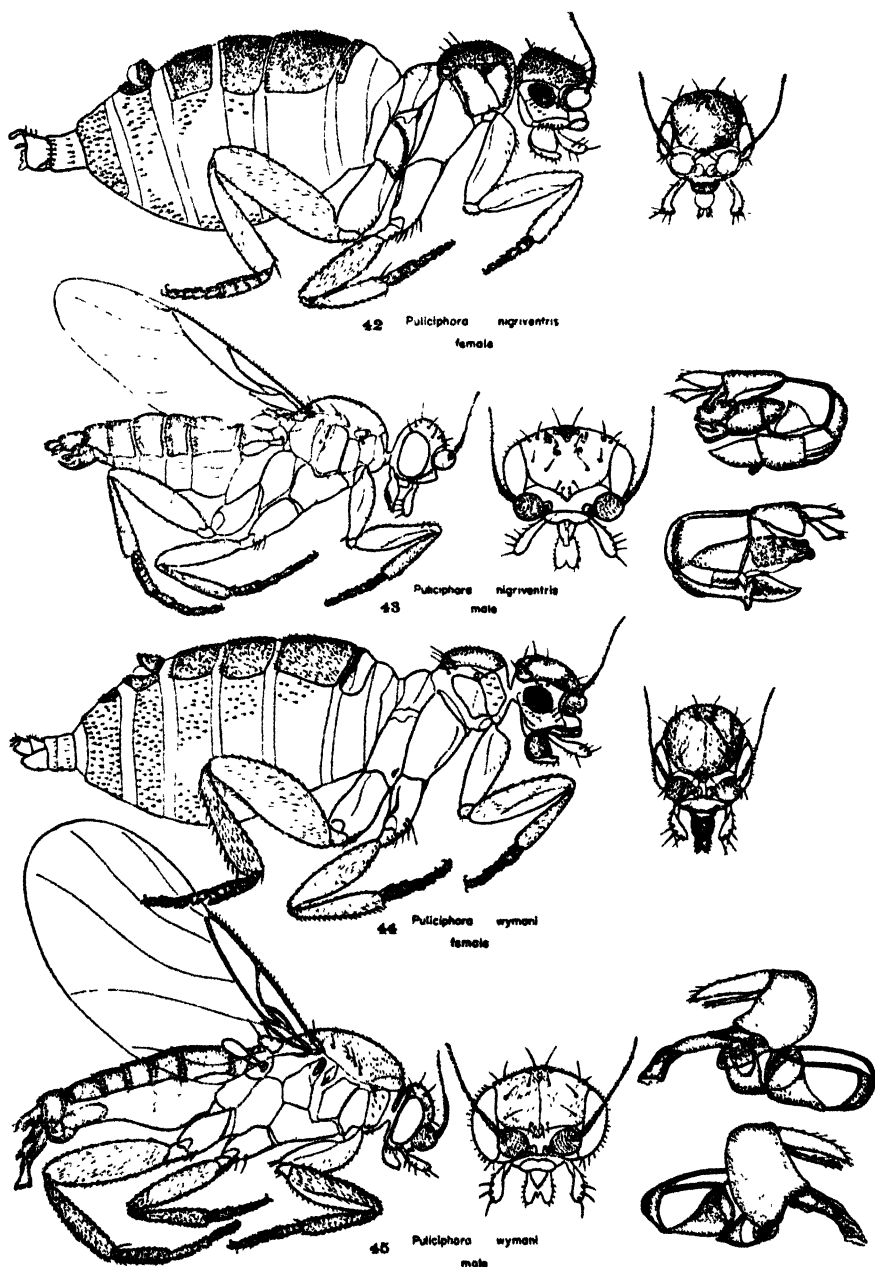
*Holotype*, male.—Length 1.1 mm.; length of wing 0.9 mm., body color a uniform dark brown, palpi, pleura, sides of abdomen, and legs light brown but not yellow; wings distinctly brownish, frons blackish brown; apex of hind femora scarcely darkened. *Head*: Frontal bristles moderately long and exceptionally thick; lower supra-antennals weaker than but extending as far forward as upper ones; *antiales much closer to lower frontals than to upper supra-antennals*; palpi very broad, with five roughly similar major bristles extending outward from outer, forward margin; labium greatly expanded in softened specimen; antennal arista no longer than height of head; cheeks apparently with only one strong bristle at genal angle and with three weak ones farther forward. *Thorax*: Dorsal hairs short but strong, becoming sparse near wing and bristly toward posterior margin; scutum and posterior edge of scutellum each with only one pair of bristles; propleura with a single dorsal posterior row of setae and two ventral bristles; mesopleura with dorsal posterior corners bearing a patch of small setae in addition to a stronger bristle; anterior spiracles enclosed in a separate sclerite. *Legs*: Moderately long, the posterior tibiae and tarsi about as long as the wings and with relative proportions of 3:4; posterior tibiae with a single dorsal row of only four or five

setae; ventral margin of posterior femora with hairs of about equal length throughout, a little weaker in the middle; metatarsi without outstanding setae on the fringes. *Wings*: Rather narrow, about one-



FIGURES 39-41.—Phoridae of Guam: 39, *Diploneura cornuta* (Bigot); 40, male of *Chonocephalus subglaber*, new species; 41, male of *Chonocephalus hirsutus*, new species.

third as broad as long and with hairs of costal fringe sparse, about 11 in each row; basal portion of  $R_{1+2}$  bearing on the inner side a seta about as long as the costal setae; veins placed as shown in figure 37.



FIGURES 42-45.—Phoridae of Guam: 42, Female of *Puliciphora nigroventris*, new species; 43, male of *Puliciphora nigroventris*; 44, female of *Puliciphora wymani*, new species; 45, male of *Puliciphora wymani*.

*Abdomen*: Tergites uniformly dark brown, sparsely hairy, the apical fringes not longer than hairs on other portions except on sixth tergite; genitalia small, aedeagus with a complex group of hornlike appendices; lamella single, with short terminal setae.

Holotype (unique) (U. S. N. M. No. 57989): Pilgo River, Guam, June 1945 (G. E. Bohart).

*Remarks*.—This species resembles *scitifemur* in general appearance but has mesopleural vestiture. It runs to *arizonensis* Malloch or *monticola* Malloch in his key (1912) but has a longer costa than *arizonensis* and differs from *monticola* in having the first two divisions of the costa subequal instead of 2:1. It also differs from *monticola* in having the outer supra-antennals only one-third as far apart as the width of the frons. It runs to *galugensis* Brues or *lahuensis* Brues in the key to Philippine species (1936) but has narrower wings than *lahuensis* and the seta on the base of  $R_{1+2}$ , which is missing in the latter. It differs from *galugensis* in its sparse costal bristles and darker color. It is apparently similar to *basiseta* from Samoa (Malloch, 1935) (hence its name) but has mesopleural vestiture.

MEGA3ELIA SCALARIS (Loew)

FIGURES 33, 34

*Phora scalaris* LOEW, Berlin Ent. Zeitschr. (Centuria VII), vol. 10, p. 53, 1866.

Length 1.6 to 3 mm.; length of wing of a 3-mm. specimen 2.8 mm., body yellowish (frons of male sometimes largely black) with indistinct brownish markings on the scutum, forming a pair of dorsal longitudinal stripes, another pair of more lateral and posterior stripes, and several angular spots anterior to these; abdomen marked as illustrated but sometimes more extensively dark so that the yellow is constricted to basal and apical bands on the second and third tergites and basal central spots on the fourth and fifth tergites. The first tergite and the apical lobes of the last always remain largely yellow; palpi, halteres, pleura, and legs (except for apices of hind femora) creamy yellow. *Head*: Frontal bristles long and moderately heavy, the supra-antennals about equidistant and the outer ones only a little stronger than the inner; antiales a little higher than the outer supra-antennals and much lower than but nearly as far apart as lower frontals; proboscis of females short and fleshy. *Thorax*: Propleura with numerous scattered hairs in addition to a dorsal posterior fringe and two to four ventral bristles; pleura otherwise bare; posterior margin of scutum with single pair of long slender bristles and scutellum with two pairs of subequal bristles; scutal pubescence dense and composed of very small hairs; halteres yellow, sometimes with darker apical spot. *Wings*: Costa distinctly longer than succeeding length of wing; veins bare except for moderately short and dense costal fringe and the usual bristles on the basal posterior margin; costa from

humeral cross vein to second longitudinal slightly longer than from the latter to apex of third longitudinal. *Legs*: Midtibiae with a weak fringe of setae outside the dorsal hair fringe as well as a stronger one inside; hind tibiae with an outer fringe composed of 9 to 12 rather strong setae; fore tibiae setose dorsally but without a definite row of setae; hind tibial spur of male nearly as long as the metatarsus. *Abdomen*: Tergites sparsely covered with short, stiff hairs laterally and with long ones apically on tergites 5 to 7. Genitalia as figured, the lamella yellow with strong terminal bristles.

This is a cosmopolitan species that breeds in a wide variety of materials. It is easily distinguished from the other species on Guam by its color pattern, types of pleural pubescence, and the male genitalia.

### Genus *DIPLONEURA* Lioy

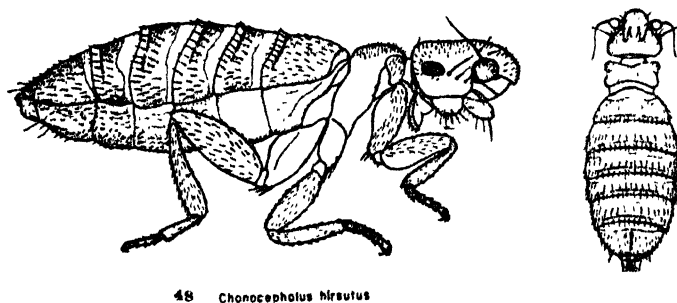
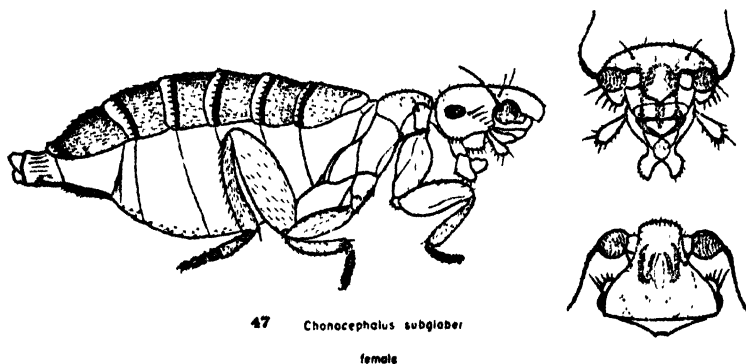
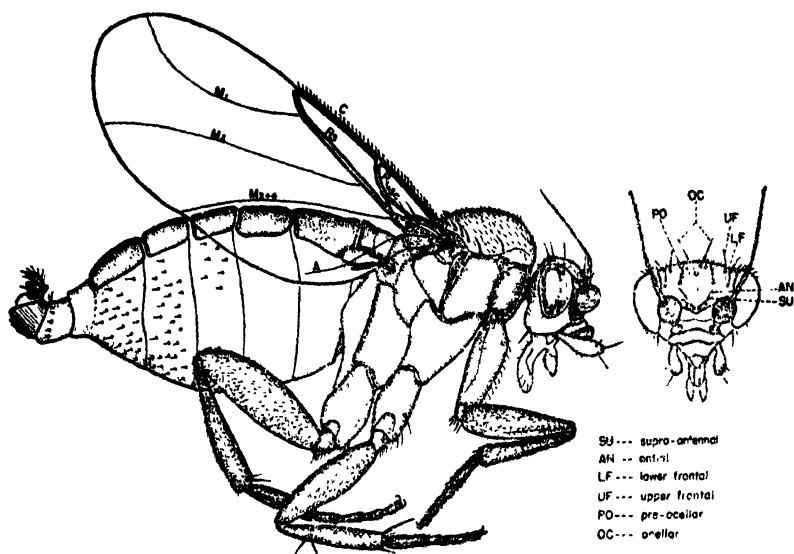
#### *DIPLONEURA CORNUTA* (Bigot)

#### FIGURE 39

*Phora cornuta* Bigot, in de la Sagra's "Histoire physique, politique et naturelle de l'île de Cuba" (French ed.), p. 827, 1857.

Length 1.4 to 2.1 mm.; length of wing of a 3-mm. specimen 0.95 mm.; color yellowish brown; frons blackish above; thorax with median and lateral brown areas; scutellum brown; abdomen yellow with blackish areas laterally and apically on tergites 2 to 5 and covering most of 6 and 7; palpi, proboscis, pleura, and legs rather clear yellow; wings hyaline. *Head*: Frons with long slender spines, averaging over half as long as width of frons; spacing as shown in figure 39; antennal arista slightly longer than head width; proboscis of female narrow, chitinized, extending one-third its length beyond palpi; palpi with five long apical and subapical spines, fourth from apex longer than antial bristles and directed downward; cheeks with two long bristles near genal angles and a single long one at level of antennal insertions. *Thorax*: Dorsum broader than long, with five bristles along each lateral margin, the longest on posterolateral corner of scutum; apical margin of scutum otherwise with one pair of long bristles and two much shorter inner pairs of hairlike ones; scutellum with one pair of long bristles on the posterolateral corners. Pubescence of pleura as shown in figure 39. *Legs*: Posterior tibiae with dense dorsal fringe of hair and a series of weak setae inside and hidden by the dorsal fringe; anterior tibiae with four setae on outer margins; inner sides of midtibiae with hairs arranged in transverse series and with apical spurs nearly as long as metatarsi; posterior metatarsi with two outstanding setae before the middle along ventral margins. *Wings*: With whitish microtrichia; placement of veins and costal fringe as shown in figure





FIGURES 46-48.—Phoridae of Guam: 46, *Parafannia molluscovora*, new species; 47, female of *Chonocephalus subglaber*, new species; 48, female of *Chonocephalus hirsutus*, new species.

39. *Abdomen*: Tergites 1 to 5 practically bare, 6 and 7 with sparse general pubescence and long apical fringe hairs; sternites distinctly setose, the longest ones on sternites 5 to 7 nearly as long as frontal bristles; ovipositor reddish with dorsal and ventral pairs of hairs as long as frontal bristles.

This tropicopolitan species is the only representative of its genus so far found on Guam. It has been recorded from southern Europe, Asia, and southeastern United States. The figures of the male genitalia should serve to distinguish it from other species, if they should be found.

It was reared on Guam from decaying mollusks and swept from vegetation along the seacoast.

### Genus CHONOCEPHALUS Wandolleck

#### CHONOCEPHALUS HIRSUTUS, new species

#### FIGURES 41, 48

*Holotype*, female.—Length 1 mm.; body brown above, testaceous beneath, with a fine transverse subapical dark brown streak extending about three-fourths the distance across each abdominal tergite. *Head*: Eyes with about 12 facets; sides of head with four bristles anterior to eyes, the posteriormost about one-third as long as head; palpi about as broad as antennae and with terminal bristles as long as palpi. *Thorax*: Propleura with numerous minute hairs but no dominant one; notal pubescence short and erect. *Legs*: Sparsely hairy; forelegs with first tarsal segment a little shorter than next two combined and about half as long as first hind tarsal segment. *Abdomen*: Only slightly darker above than below; tergites 2 to 5 with two transverse rows of setae, except laterally where there are about 10 setae on each segment as strong as the ones in the transverse rows; fifth and sixth sternites with small setae laterally; sternites 4 to 7 with ventral setae, the apical ones on sternite 7 longer than setae in the tergal rows; spatula-shaped sternal structure with "handle" about three times as long as "blade" and with "blade" about as wide as long.

*Allotype*, male.—Length 1.1 mm.; length of wing 1 mm.; blackish brown, somewhat velvety; antennae, palpi, pleurae, and legs brown; wings lightly infuscated. *Head*: Bristles weak, the postocellars and lowermost frontals the strongest; median groove of frons narrow, not dividing the lower portion into two widely separated ridges. *Thorax*: Dorsal pubescence sparse and fine; posterior scutal margin with four bristles, the basal pair about half as long as the apical. Lateral vestiture as in figure 41. *Wings*: Veins very delicate; costal fringe composed of many short, weak setae; humeral cross vein and subcosta absent. *Abdomen*: First tergite as long as second

and sixth twice as long as fifth; tergal pubescence minute; genitalia large, the right side with a long bootlike process; the left side with its hair fringe mainly confined to a single row close to posterior border.

Holotype female and allotype male (U. S. N. M. No. 57994) : F. E. A. Farm, near Agana, Guam, October 1945, female taken from pig dung, male swept from above mud in the pig pen (G. E. Bohart). Paratype male: From light trap, Point Oca, Guam, June 1945 (G. E. Bohart and J. L. Gressitt).

*Remarks.*—The two specimens of males (both mounted in euparal) vary in the extension of the aedeagus and the expansion of the wings, but this is due to mounting techniques. The allotype has one mesopleural bristle whereas the paratype has two. The holotype is mounted in euparal but is unfortunately somewhat collapsed and shrunken. This species is close to *subglaber*, but the female has stronger and more numerous abdominal setae and a more uniform abdominal color. The male genitalia also differentiates it from *subglaber* and from other species for which genitalia have been described or figured.

CHONOCEPHALUS SUBGLABER, new species

FIGURES 40, 47

*Holotype*, female.—Length 0.9 mm.; dark brown to blackish brown above, brown laterally on thorax and creamy white laterally and ventrally on abdomen; abdominal tergites with broad, complete transverse preapical black bands containing pale circles at the bases of the fringe setae. *Head*: Eyes with about 15 facets; sides of head with five bristles anterior to eyes, the posteriormost about one-fourth as long as head; palpi narrower than antennae. *Thorax*: Propleura with a dorsal bristle in addition to scattered small setae. *Abdomen*: Tergal pubescence scattered and minute except in preapical fringes; bases of fringe hairs completely enclosed in the broad preapical black stripes; sternites 4 to 6 with a few minute setae medially and sternite 7 with a median sclerite bearing short setae; spatula-shaped sternal structure with "handle" less than three times as long as "blade."

*Allotype*, male.—Length of wing 1 mm.; body color as in *hirsutus*. *Head*: Bristles moderately strong, those extending from the eye along the anterior margin of the frons and along the forward prolongation of frons gradually diminishing in strength but most of them as strong as postocellars or postverticals; median groove broad and shallow, separating forward prolongation of frons into widely separate ridges. *Thorax*: Hairs of propleura scattered and mesopleura with three setae. *Legs*: As in *hirsutus* but not so sparsely pubescent. *Wings*: Costal fringe short, with numerous hairs, those on basal half

distinctly longer and sparser than elsewhere. *Abdomen*: Sixth tergite only one and one-half times as long as fifth and with noticeable hairs in addition to apical fringe; genitalia without a strong bootlike process on left side but with a fingerlike process on the right side bearing an apical peg and a thick spine beyond the middle.

Holotype female (U. S. N. M. No. 57995) and 15 paratype females: Point Oca, Guam, June 1945, from breadfruit (G. E. Bohart and J. L. Gressitt).

Allotype male (U. S. N. M. No. 57995): Point Oca, Guam, June 1945 (G. E. Bohart and J. L. Gressitt); 3 paratype males: Point Oca, December 1945 (reared from bananas by J. L. Gressitt).

*Remarks*.—The female differs from *hirsutus* by its weaker abdominal pubescence and stronger transverse dark bands on the abdomen. It is almost identical with *buccalis* Malloch in the female but males are readily distinguishable by the genitalia. The male differs from *hirsutus* chiefly in the stronger frontal bristles and in the genitalia. It differs from the closely related *buccalis* Malloch (1912) and from any of the species described from the Bismarck Archipelago by Schmitz (1929a, pl. 1) by the genitalic processes mentioned in the above description.

#### Genus PULICIPHORA Dahl

##### PULICIPHORA WYMANI, new species

FIGURES 44, 45

*Holotype*, female.—Length 1.1 mm.; brown above and pale testaceous beneath; frons usually with indefinite median and oblique sublateral darker bars; thoracic pleura without dark areas. *Head*: Frons with only one pair of lower frontals. *Thorax*: Propleura with a few scattered setae in addition to the dorsal bristle; dorsum with three pairs of bristles, the lateralmost inserted near posterior corners of mesopleura. *Legs*: Hind tibiae with hairs of dorsal margin longer and stouter than elsewhere on legs. *Abdomen*: Tergite 6 with a small, lunular sclerite at the base; sternite 5 uniformly ringed with setae; sternite 2 with a group of setae just below the tergite.

*Allotype*, male.—Length 1.2 mm.; length of wing 1.1 mm.; thorax dark brown above, light brown beneath; dorsum of abdomen and frons blackish brown. *Head*: Antiales about as far apart as the lower frontals; palpi with five strong bristles. *Thorax*: Propleura with scattered setae in addition to dorsal bristle; posterior border of thorax with one pair of bristles near the lateral corners; scutellum with four bristles, the inner ones about two-thirds as long as the outer. *Legs*: Midtarsi only slightly longer than midtibiae, about equal to fore tarsi. *Wings*: Very broad, with radial vein ending at about middle. *Abdomen*: Genitalia large, with an anteriorly developed ventral loop and

an extensible process, apical lamella elongate and with a slender ventral lobe.

Holotype female, allotype male (U. S. N. M. No. 57997), 6 paratype males, and 10 paratype females: Point Oca, Guam, June 1945, from dead shellfish, and December 1945 from canned salmon (G. E. Bohart and J. L. Gressitt).

*Remarks.*—Females are somewhat variable in the distinctness of the head markings and in the color of the haustellum, which may be light or dark. Males sometimes have the terminal process (aedeagus) of the genitalia retracted.

This species can be distinguished in the female from *nigriventris* by the paler dorsal color, lack of dark pleural areas, and more complete abdominal setosity. The male can be told from *nigriventris* and other species by its large aedeagus and the anterior loop of its associated genitalic structures.

The fly is named for C. L. Wyman, who worked with me many months overseas and in Washington, D. C.

**PULICIPHORA NIGRIVENTRIS, new species**

**FIGURES 42, 43**

*Holotype, female.*—Length 1 mm.; clypeus, frons, antennal grooves, sides of pronotum, anterior margins of propleura, anterior band, and ventral surface of sternopleura black; legs, antennae, palpi, proboscis, cheeks, occiput, central portions of thoracic pleura and metanotum, basal two-thirds of first abdominal segment, and basal lunule of fifth segment yellowish brown or testaceous; abdominal sternites and all of abdomen beyond segment 5 creamy to translucent whitish. *Head:* With two pairs of lower frontals and with supra-antennals about as long as postocellars. *Thorax:* Propleura with only one distinct seta; posterior margin of scutum with two pairs of subequal bristles. *Legs:* Hind tibiae with hairs of dorsal margin rather long but no stouter than elsewhere on the tibiae. *Abdomen:* Segment 5 (with dorsal gland) with rows of setae which are incomplete laterally; segment 2 without lateral setae; segment 6 without a dorsal sclerite.

*Allotype, male.*—Length 1.2 mm. (expanded), length of wing 0.9 mm. (incompletely formed); blackish brown, thorax somewhat lighter. *Head:* Antiales much closer together than lower frontals; palpi with four strong bristles. *Thorax:* Propleura with only one distinct hair or bristle; prothoracic spiracle in a distinct sclerite. *Legs:* Midtarsi considerably longer than foretarsi or midtibiae. *Wings:* Poorly developed in holotype because of teneral condition. *Abdomen:* Genitalia not particularly large; apical lamella short and with prominent ventral lobe; ventral portion of genitalia not produced basally into abdomen.

Holotype, allotype (U.S.N.M. No. 57996), and 8 paratypes (including one male): Point Oca, Guam, June 1945, reared from dead shellfish (G. E. Bohart and J. L. Gressitt).

*Remarks.*—This species resembles *wymani* but can be distinguished by its blacker color and fewer abdominal setae in the female and by the smaller, simpler appearing genitalia in the male. It comes close to *tokyoensis* Kinoshita (see Schmitz, in Lindner, 1938) but lacks the mesopleural bristle and scattered propleural setae of the latter.

#### PARAFANNIA, new genus

*Head:* Clypeus convex and strongly projecting, separated from antennal scrobes by membranous area; third antennal segment subspherical, with arista inserted dorsally and over twice as long as frons; cheeks produced ventrally and posteriorly, the genal angles considerably below and behind the nearest margin of the eyes and bearing a single long bristle; cheeks otherwise with only a few short bristles at inner angles, palpi with only two long bristles near apices, with two rows of lesser ones extending along entire outer and ventral sides; proboscis fleshy, broadly and deeply bilobed; frons much broader than long, with one pair of erect supra-antennals, one pair of outwardly directed antiales, two pairs of laterals, the lowermost only slightly below the level of preocellars; upper verticals directed inward and postverticals directed outward; ocelli rather small and far separated. *Thorax:* Scutum about two-thirds as long as broad, with six pairs of lateral bristles, one pair along truncate posterior margin; scutellum posteriorly with one pair of bristles and with strongly convex posterior margin; propleura lateral, about twice as high seen from the side as posterior portion of pronotum; anterior spiracles not above dorsal margins of pro- and mesopleura; mesopleura not divided into anterior and posterior sections, more than twice as high as dorsal length, entirely bare; a distinct 5-sided sclerite separated from the hypopleura and interposed between the latter and the pteropleura; postnotum shorter than scutellum. *Legs:* Dorsal side of foretibiae with a single subbasal seta, which is somewhat stronger than hairs along dorsal margin; midtibiae with a subbasal pair of strong bristles on dorsal side, with two strong bristles near apex; hind tibiae without dorsal hair fringes, with a single strong bristle on outer side one-third the distance from base to apex, and apically with a short subdorsal bristle in addition to two moderate ventral bristles. *Wings:*  $M_{2+3}$  (second longitudinal) not separated apically from  $M_{4+5}$  (third longitudinal);  $R_1 + Sc$  (first longitudinal) short; base of  $R_s$  on inner side with long bristle; veins not swollen and pterostigmae lacking. *Abdomen:* Nearly bare dorsally except for apical fringe of sixth tergite, laterally and ventrally with short setose hairs set in distinct sockets (as in *Puli-*

*ciphora*); ovipositor, when exerted, composing seventh and eighth segments, which are tubular and have fine chitinated striae, and terminal structures composed of a dorsal piece connected to a pair of ventral sclerites and a pair of spatulate distal processes.

This genus is in the subfamily Phorinae of Schmitz and runs close to *Citrigo* Schmitz in his key to the world genera (1929a). It differs from this, however, in the possession of an anterodorsal bristle on the hind tibiae and in the strongly produced clypeus. It differs from *Hypocera* in having bare mesopleura and from *Diploneura* in lacking a free end to the radial vein.

Type of the genus: *Parafannia molluscovora*, new species.

**PARAFANNIA MOLLUSCOVORA, new species**

**FIGURE 46**

*Holotype*, female.—Length (expanded) 2.2 mm.; length of wing 1.6 mm.; sooty black, antennae, palpi, legs, pleura dark yellowish brown to dark brown or nearly black, halteres smoky brown, sides and venter of abdomen smoky yellow, becoming sooty apically; wings slightly infuscated, veins brown. *Head*: Frons about twice as broad as long; antiales over twice as close to supra-antennals as to eyes; lower frontals and preocellars nearly in line; clypeus with a dark basal band. *Thorax*: Scutum with rather sparse brownish pubescence; scutellar bristles longer than scutellum and bending inward; hindmost pair of lateral scutal bristles about as long as distance from humeral cross vein to apex of the radius; propleura with one slender seta on posterior angles, two or three small hairs near the posterior margins, and three small setae near the ventroposterior corners. *Legs*: Hind tibiae and tarsi together about four-fifths as long as wings, the tibiae four-ninths as long as tarsi; subbasal bristle on hind tibiae about as long as tibial width at that level; posterior metatarsi one-fourth as broad as long; dorsal margins of midtibiae mostly smoky yellow but with broad dark band in region of subbasal pair of bristles; subbasal bristle on inner dorsal margins of foretibiae shorter than tibiae width. *Wings*: Setae fringe of costa short, dense, and regular; prehumeral portion of costa with two long bristles; bristle on base of Rs about as long as lateral bristles on frons; placement of veins as in figure 46. *Abdomen*: First tergite about half, third about two-thirds as long as second; tergites 1 to 5 practically bare except for tiny apical fringes; sides and venter of abdomen with scattered setae, which become longer and more numerous toward apical segments and have black pigmentation at their bases; processes at tip of ovipositor with a few long hairs; seventh and eighth abdominal segments (forming "tube" of ovipositor) finely striated with black, the latter with a pair of dorsal longitudinal chitinous rods.

Holotype (U. S. N. M. No. 57993) and 15 female paratypes: Point Oca, Agana, Guam, June 1945, reared from decaying mollusks buried in ant colonies just beneath the ground surface (G. E. Bohart and J. L. Gressitt).

*Remarks.*—This fly is so distinctive that a new genus was erected for it. Other species, if found, may show that some of the characters used in the generic description are of specific value only.

Although over 30 specimens were reared, no males were obtained.

## KEY TO THE PHORIDAE OF GUAM

- |  |                                 |
|--|---------------------------------|
| 1. Wingless .....  | 2                               |
| Winged .....   | 5                               |
| 2. Head strongly flattened dorsoventrally and with front produced beyond antennae; dorsum of thorax without strong bristles; eye smaller than antenna. ( <i>Chonocephalus</i> ) .....  | 3                               |
| Head neither flattened nor conspicuously produced; dorsum of thorax with several pairs of strong bristles; eye larger than third antennal segment. ( <i>Puliciphora</i> ) .....  | 4                               |
| 3. Abdomen, view from side, with tergites uniformly haired and without distinct apical fringes; venter of abdomen light brown, almost as dark as dorsum .....  |                                 |
| Abdomen with very fine sparse hairs except for apical fringes of tergites; blackish dorsum of abdomen contrasting strongly with creamy white venter .....  | <i>Chonocephalus hirsutus</i>   |
| 4. Frons, mesonotum, and first 5 abdominal tergites uniformly blackish; thoracic pleuron strongly marked with dark gray along most sutures; hind tibia without noticeable fringe of bristles or stiff hairs; fifth abdominal segment not uniformly ringed with several rows of hairs or short bristles ..... | <i>Puliciphora nigriventris</i> |
| Most of frons and much of mesonotum and abdominal tergites testaceous to brown, not strongly different from thoracic pleural color; fifth and sixth abdominal segments uniformly ringed with short bristles or hairs; hind tibia with distinct posterior fringe of strong hairs or bristles.                 |                                 |
|  | <i>Puliciphora wymani</i>       |
| 5. Frons covered with long, strong bristles and not produced forward between antennal bases .....  | 7                               |
| Frons with at most 2 or 3 pairs of strong bristles and produced forward between antennal bases. ( <i>Chonocephalus</i> ) .....   | 6                               |
| 6. Frons broadly impressed medially, from above appearing like a pair of ridges between antennal bases, and with anterior border near eyes having a series of 3 or 4 moderate bristles; mesopleuron with several setae .....   | <i>Chonocephalus subglaber</i>  |
| Frons narrowly impressed along midline and with bristles along anterior border scattered and weak; mesopleuron with a single seta.   |                                 |
|  | <i>Chonocephalus hirsutus</i>   |
| 7. Radial sector unbranched .....  | 8                               |
| Radial sector branched near apex .....   | 10                              |
| 8. Clypeus strongly produced forward at oral margin; hind tibia with a spine on outer surface toward the base; midtibia with a pair of bristles toward base .....  | <i>Parafannia molluscovora</i>  |
| Clypeus not produced at oral margin; tibiae without basal or sub-basal bristles. ( <i>Puliciphora</i> ) .....  | 9                               |



9. Propleuron with about 5 small setae in addition to the dorsal bristle; genitalia with long anteroventral extension.....*Puliciphora wymani*  
 Propleuron with dorsal bristle only; genitalia without conspicuous anteroventral extension.....*Puliciphora nigriventris*
10. Preantennal bristles (on anteromedian margin of frons) directed backward; midtibia with a pair of subbasal bristles.....*Diploneura cornuta*  
 Preantennal bristles directed forward; midtibia without bristles before middle. (*Megaselia*) ..... 11
11. Abdomen with extensive yellow areas anteromedially on most tergites.... 12  
 Abdomen black or dark brown above..... 13
12. Fourth and fifth abdominal tergites entirely pale; frons with inner preapical bristles much shorter than outer ones.....*Megaselia suis*  
 Fourth and fifth abdominal tergites partially dark; frons with inner preapical bristles nearly as long as outer ones.....*Megaselia scalaris*
13. Posterodorsal corner of mesopleuron with a patch of small setae..... 14  
 Posterodorsal corner of mesopleuron without setae; basal half of ventral margin of hind femur with 4 or 5 long hairs.....*Megaselia setifemur*
14. Posteroventral corner of mesopleuron with a small bristle in addition to setae; costal margin of wing with about 11 bristles, which are longer than distance between costa and radius.....*Megaselia parabasiseta*  
 Posteroventral corner of mesopleuron with uniform setae only; costal margin with about 15 short bristles.....*Megaselia stuntzi*

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A GENERIC REVISION OF THE ICHNEUMON-FLIES OF  
THE TRIBE OPHIONINI

By R. A. CUSHMAN

A NUMBER of years ago I planned a revision of the North American species of the hymenopterous genus *Ophion* and to that end assembled from many sources a great number of specimens. Study of this material made it evident that *Ophion* as we had known it was made up of several more or less discordant elements and indicated the need of a generic revision of the tribe Ophionini. This was undertaken, with the results set forth in the following pages.

Unfortunately, representatives of a considerable number of the described genera have been unavailable to me, and some of these I have found impossible to place in my arrangement because of the inadequacy of the descriptions. Several, however, I have been enabled to place through the generous cooperation of J. F. Perkins, of the British Museum. Such characters as the possession or lack of the postpectoral carina, the position of the second abdominal spiracle, the presence or absence of a fenestra when scleromes are lacking, and even the form of the mandibles and the course of the radius are, in many cases, not referred to in generic descriptions; and every description omits mention of one or more of the series of characters which I have chosen for use as generic group characters. Most of the genera of which no identified specimens are available and of which I have been unable to identify any species in the large amount of material before me are not included in the key to genera. However, the probable affinities of each are discussed.

Study of such genera as have been available to me has led to the discovery of a number of characters not previously employed in the classification of the group. Using these characters, together with the best of the old characters and others gleaned from generic and specific descriptions, I have attempted to produce a more nearly natural classification than any published heretofore.

#### SOURCES OF MATERIAL

This study is based principally on material in the collection of the United States National Museum, which contains specimens of Ophionini from all the zoogeographic regions of the earth, including representatives of a majority of the previously described genera and of all the new genera described in this revision. A vast amount of North American material, mostly referable to *Ophion* and *Enicospilus* secured on loan from the collections of many institutions and private collectors, has been studied. Particularly important, with respect to the present revision, are the collections received from the California Academy of Sciences, the American Museum of Natural History, the University of Kansas, Cornell University, and the private collection of Henry K. and Marjorie C. Townes, since these contain material of many more of the Nearctic genera other than *Ophion* and *Enicospilus* than do any of the others. To these and to other institutions from which material was secured I hereby extend my thanks.

#### ILLUSTRATIONS

All the figures, except plate 55, figure 71, were drawn by Arthur D. Cushman, scientific illustrator, U. S. Bureau of Entomology and Plant Quarantine. I am grateful to him for the accuracy of his drawings.

#### TRIBAL CHARACTERS AND RELATED TRIBES

Among the tribes of the Ophioninae are three, Ophionini, Hellwigiini, and Anomalini (Nototrachini), that have traditionally been separated from the rest of the tribes in tribal keys by the single character of the position of the second recurrent vein basad of the intercubitus. This has resulted in the placing in the Ophionini of genera, especially certain genera of Therionini, that obviously do not belong there when other characters are taken into consideration.

Some authors have included *Hellwigia* Gravenhorst in the Ophionini, while Morley unites the Anomalini with Ophionini and excludes *Hellwigia*. The genera *Hellwigia* and *Hellwigiella* Szépligeti are obviously not at all closely related. Since this paper was sent to press I have, through the kindness of Dr. H. K. Townes, been able to examine specimens of both genera. *Hellwigiella* I find to belong to the Ophionini, but *Hellwigia* I believe to belong to the Campoplegini, as indicated on a later page.

The genus *Ophiopterus* Brullé has consistently been referred to the Ophionini because of the strongly antifurcal second recurrent vein, but in all other respects it is therionine.

Another tribe that comes into the complex is the Ophionellini, made up of the venationally anomalous *Ophionellus* Westwood and *Hymenopharsalia* Morley (*Pharsalia* Cresson), the latter referred by Ashmead to the Anomalini because of the single calcarium on the middle tibia. *Ophionellus* is unknown to me, but, in my opinion, all the other characters of *Hymenopharsalia* ally it too closely with such therionine genera as *Atrometus* Foerster and *Podogaster* Brullé to justify either placing it in the Anomalini or maintaining it as a distinct tribe.

The following diagnosis in key form should present no difficulty in the placing of a genus in its proper tribe:

KEY TO THREE OF THE TRIBES OF THE SUBFAMILY OPHIONINAE

1. *Mandible*, when closed and in cephalic view, with lower tooth not directly posterior to upper tooth, but at a lower level and visible; *eyes* parallel or divergent below, never distinctly convergent (i. e., face not narrower than frons), always at least shallowly emarginate opposite antennal foramina; *occipital carina* medially far below level of posterior ocelli, fading out below or joining hypostomal carina at a considerable distance from lower articulation of mandible, rarely entirely absent; *epomia* entirely lacking; *propodeal spiracle* lateral in position, very long and slitlike; *front tibia* without a minute tooth at apex opposite calcarium; *middle tibia* with two calcaria; *claws* usually long, each with a strong, many-toothed pecten; *second recurrent vein* basad of intercubitus by a distance nearly or quite as great as length of intercubitus; *intercubitus* strongly oblique and nearly continuous with basal abscissa of radius; *nervellus* sharply broken, discoidella distinct, rarely nervellus not broken but interstitial at its upper end with discoidella; *hind tarsus* with apical two joints not especially small; *ovipositor* rarely exerted. . . . **Ophionini**
- Mandible*, when closed and in cephalic view, with lower tooth directly posterior to upper tooth and not visible; *eyes* more or less convergent and at most with inner margins arcuately concave; *occipital carina* medially usually at or near level of posterior ocelli and joining hypostomal carina very close to lower articulation of mandible, sometimes (Anomalini, *Anomalon verbosum* Cresson) far below ocelli, rarely (*Podogaster* Brullé) fading out below and not reaching hypostomal carina or (*Clatha* Cameron) obsolete medially; *epomia* strong, originating on lower anterior margin of pronotum and running dorsad nearly to dorsal margin; *propodeal spiracle* subdorsal in position and long or short oval but not slitlike; *front tibia* with a minute tooth at apex opposite calcarium; *middle tibia* usually with two calcaria, but sometimes (Anomalini, *Hymenopharsalia*, *Ophionellus*, and an unnamed North American genus of Therionini) with only one; *claws* simple or at most weakly pectinate and usually small; *second recurrent vein*, except in Anomalini and genus *Ophiopterus*, distad of intercubitus or proximad by a distance much less than length of intercubitus, rarely (*Hymenopharsalia*, *Ophionellus*) entirely absent; *intercubitus* perpendicular or nearly so, at least not nearly continuous with basal abscissa of radius; *nervellus* broken or unbroken; *hind tarsus* usually with apical two joints small; *ovipositor* usually distinctly exerted. . . . . 2

2. *Second recurrent vein* far basad of intercubitus; *middle tibia* with only one calcarium; *occipital carina* medially far below level of posterior ocelli.

**Anomalini**

*Second recurrent vein* usually distad of intercubitus, occasionally slightly basad, rarely (*Ophioplerus*) far basad or (*Hymenopharsalia*, *Ophionellus*) entirely absent; *middle tibia* with two calcaria, rarely (*Hymenopharsalia*, *Ophionellus*, and an unnamed North American genus) with only one; *occipital carina* medially almost at level of posterior ocelli, rarely (*Anomalon verbosum* Cresson) far below -----

**Therionini**

### HOST RELATIONS AND LARVAL CHARACTERS

Host relations and larval characters indicate that the three tribes, Ophionini, Anomalini, and Therionini, are distinct natural groups and support the placing of *Hymenopharsalia* in the Therionini. The Ophionini are internally parasitic in lepidopterous larvae, the Anomalini in coleopterous larvae, and the Therionini in lepidopterous pupae.

My knowledge of the larvae is based largely on exuviae extracted from cocoons or host pupae from which known specimens were reared. The most significant characters are to be found in the sclerotization of the margins of the head capsule and mouth parts. In the accompanying illustrations of these sclerotizations in typical genera of each of the three tribes, quite different patterns will be noted.

In the ophionine larva (pl. 49, figs. 1-3) the entire labium (*lm*) except the areas surrounding the palpi (*lp*) is lightly sclerotized, with a more heavily sclerotized horseshoe-shaped sclerome (*sd*) around the opening of the silk duct in a deep emargination on the upper margin; there is no sclerotic bridge across the clypeus, the sclerotization extending for only a short distance along the frontal suture (*f*) above the dorsal articulation of the mandible; the hypostomal margin (*hy*) of the epicranium is heavily sclerotized with a long branch (*st*) extending across the maxilla and a somewhat less heavily sclerotized extension (*oc*) downward along the margin of the occipital foramen; the lower margin of the stipes of maxilla (*mx*) is heavily sclerotized and the surface of the cardo (*cd*) of maxilla lightly so; the mandibles (*md*) are extremely small.

In the therionine larva (pl. 49, figs. 5-8), on the other hand, the labium is sclerotized only along its superior lateral margins and the margins of the silk duct opening, its lower margin being very poorly if at all defined; there is a strong sclerome across the clypeus (*cl*), fused laterally with the pleurostomal margins, thus forming with the hypostomal margin a strong brace extending entirely across the head above the mouth, and sometimes spreading far back from the margins, notably so in *Therion* and *Heteropelma*; the very heavily sclerotized hypostomal margin lacks entirely the branch across the maxilla and the extension along the occipital foramen; the sclerotized margin of the stipes of the maxilla is long and slender and there is no evident

sclerotization of the cardo; the mandibles are very stout and overlap across the median line.

The anomaline larva (pl. 49, fig. 4) is, in some respects, more or less intermediate between those of the other two tribes. The labial ring is narrow but apparently complete, although its lower margin perhaps outlines the palpal areas rather than the actual basal margin of the labium, and there is a median extension between the palpal areas; the brace across the head above the mouth is complete but slender, and the part across the clypeus is much more arched than in the therionine larva; the maxillary branch is present but very short; the marginal sclerome of the maxillary stipes is long and slender and the cardo is not sclerotized, the mandible is stout at the base with a long slender point, the two mandibles nearly meeting on the median line.

#### TERMINOLOGY

For the most part the terminology employed is that characteristic of the vast bulk of the literature of the Ichneumonidae, and that of the wing veins and cells is in general that of Rohwer and Gahan's "Horismology of the Hymenopterous Wing."<sup>1</sup> A few new or unusual terms, however, need definition:

*Abscissula*.—The basal abscissa of radiella (pl. 53, fig. 52).

*Basal constriction of propodeum*.—The constriction dividing that part of propodeum basad of the basal carina or its normal position into *frenum* (anterior portion) and *basal area* (posterior portion) (pl. 52, figs. 43, 44).

*Epipleura*.—The lateral portions of the tergites extending as free flaps beyond the line of attachment of the ventral membrane. On tergite 2 the epipleura are usually set off by carinae and are inflexed, but are not so defined or inflexed in the *Thyreodon* group and in a few other genera.

*Fenestra*.—A hairless area in the apical portion of the discocubital cell usually more or less outlined by sclerotic thickenings (*scleromes*) and frequently also with one or more scleromes on its surface. This and its parts are fully described and discussed in my paper on the Ichneumonidae of the Sauter Formosan collection<sup>2</sup>; and the terminology of the parts is indicated on figure 52 of the present work. This structure is characteristic of *Enicospilus* and absent in the *Ophion* and *Thyreodon* groups of genera (pl. 53, fig. 50).

*Paramere*.—One of the paired outer valves of the male genitalia (pl. 55, figs. 84, 85).

*Postnervulus*.—The combined second and third abscissae of the brachius (pl. 53, fig. 52).

<sup>1</sup> Proc. Ent. Soc. Washington, vol. 18, pp. 20-76, 1916.

<sup>2</sup> Arb. morph.-tax. Ent., vol. 3, p. 302, fig. 14, 1937.

*Postpectus*.—The incurved part of mesosternum anterior to middle coxae, frequently defined by transverse carinate extensions of the carinae that flank the coxal foramina (pl. 52, figs. 36–38, 40, 42).

*Postpectoral carina*.—The carina defining the postpectus.

*Pronotal sinus*.—A cleft in the humeral angle of pronotum between the humeral angle itself and the flange by which the pronotum is attached to mesopleuron. In *Ophion* and *Thyreodon* the sinus is broad, exposing the spiracular sclerite, whereas in *Enicospilus* it is narrow and the spiracular sclerite is hidden by the humeral angle (pl. 55, figs. 72–74).

*Spiracular sclerite*.—A small, free sclerite between the base of the tegula and the humeral angle of the pronotum, sometimes concealed by the latter (pl. 55, figs. 72–74).

*Transverse brace*.—The combined intercubitus, second abscissa of cubitus and second recurrent vein. The comparative lengths of these elements is stated as a ratio, e. g., 1:2:4, the figures representing the veins in the same order as mentioned above (pl. 53, fig. 52).

*Umbo of second tergite*.—A median, convex, polished articulating area at base of second tergite set off laterally by pits and usually dorsally by a constriction or impression. It is characteristic of the *Ophion* group of genera and undeveloped in the *Enicospilus* and *Thyreodon* groups (pl. 56, figs. 94–99).

### Tribe OPHIONINI

#### GROUP CHARACTERS AND GENERIC CHARACTERS

In order to construct a key placing the genera in as near their natural relationship as possible it has been necessary in most cases to employ groups of characters rather than single characters. A vast majority of the species of the tribe belong to the genera *Ophion*, *Enicospilus*, and *Thyreodon*, and the principal couplets, Nos. 1 and 7, of the key embody the most significant characters distinguishing typical members of those genera. Although the characters in couplet 7 are stated positively, not all the genera or, indeed, all species of the basic genera agree with all the characters applying to the categories in which they belong. Agreement with a majority of the characters in either alternate determines the subsequent course of a specimen through the key.

Very few of the characters employed in the key are peculiar to single genera or even to single groups of genera. The anomalous hind claws (pl. 55, fig. 77) and frenulum (pl. 54, fig. 56) of *Spilophion*, the notched apical front tarsal joint of *Ophiogastrella* (pl. 55, fig. 75), and the remarkably long and slender ligula of *Agathophiona* (pl. 50, fig. 28) apparently occur in no other genus, and are of themselves diagnostic.

Of the characters in the first couplet of the key none by itself is entirely diagnostic of the members of the *Therion* group of genera, with the exception of the recurved and pointed or narrowly rounded clypeus. The narrow tapering stigma occurs in *Stauropoctonus* and even in some species of *Enicospilus*; the strongly reclivous nervellus with the fracture far above the middle in several genera of the *Ophion* group and even in some species of *Ophion*; the unseparated epipleura of tergite 2 in *Aulophion* (a new genus) and in some species of *Enicospilus*; while the broad, weakly twisted mandible differs only in being stouter than in *Ophion*. Only genera possessing all these characters properly belong in the *Thyreodon* group.

Of the characters of the *Ophion* group the gradually narrowed and weakly twisted mandible occurs also in *Spilophion* and even in a few species of *Enicospilus*, which genus exhibits all degrees of torsion from that of *Ophion* nearly to the extreme twisting found in *Stauropoctonus*; the triangular stigma occurs in *Abanchogastra*; the lack of the fenestra in *Banchogastra*, *Pycnophion*, *Abanchogastra*, and *Stauropoctonus*, all belonging to the *Enicospilus* group; the curved abscissula in *Spilophion* and *Abanchogastra*.

The strong postpectoral carina of the *Enicospilus* group occurs in *Aglaophion* of the *Thyreodon* group and in *Clistorapha* (a new genus) of the *Ophion* group, and is absent in *Aulophion*.

In some genera of both the *Ophion* and *Enicospilus* groups the basal abscissa of the radius is neither straight and unthickened as in *Ophion* nor thickened in the middle and sinuate as in typical *Enicospilus*, but is thickened and curved basally.

The occipital carina, normally complete or very nearly so, is entirely lacking in a few genera of the *Ophion* and *Enicospilus* groups.

#### KEY TO THE GENERA OF THE OPHIONINI

1. Clypeus more or less distinctly recurved apically and acute or sharply rounded (rarely narrowly truncate) (pl. 51, figs. 32-35); stigma (pl. 53, fig. 50) extremely narrow, hardly broader than apex of combined costa and subcosta and merging gradually into metacarpus, radius nearly at base; nervellus (pl. 53, fig. 50) strongly reclivous and usually broken distinctly above middle; epipleura of tergite 2 not distinctly separated from tergite; mandible (pl. 51, figs. 32-35) very broad and very little twisted (see couplet 7)..... 2  
     Clypeus not as described above or the insect differs by one or more of the other characters..... 6
2. Postpectoral carina incomplete or absent (pl. 52, figs. 37-39)..... 4  
     Postpectoral carina complete (pl. 52, fig. 36)..... 3
3. Radius basally, basal vein, and abscissula not thickened; nervellus broken at about upper third..... 4. *Aglaophion* Cameron  
     Radius basally, basal vein, and abscissula thickened; nervellus broken far below upper third..... 5. *Euryophion* Cameron



4. Tropi of normal form; propodeum extending far over hind coxae (pl. 51, figs. 29, 30)----- 5
- Tropi anthophagous, both labium and maxillae unusually long (pl. 50, fig. 25); propodeum hardly extending beyond insertions of hind coxae (pl. 51, fig. 31)----- 3. *Rhynchophion* Enderlein
5. Joint 2 of maxillary palpus not inflated; ocelli small, distant from eyes; hind coxae (pl. 51, fig. 29) not or barely extending beyond apex of propodeum.
1. *Thyreodon* Brullé
- Joint 2 of maxillary palpus inflated; ocelli very large, usually touching eyes; hind coxae (pl. 56, fig. 87) extending beyond apex of propodeum by nearly half their length.----- 2. *Athyreodon* Ashmead
6. Hind coxae not extending beyond apex of propodeum; (mandible not strongly twisted; tergite 3 emarginate at apex; tarsi stout).
6. *Orientospilus* Morley
- Hind coxae extending beyond apex of propodeum.----- 7
7. [Agreement with a majority of the characters in either alternate determines the subsequent course of a species through the key.] Mandible gradually narrowed from base to apex, not conspicuously twisted (pl. 50, figs. 17-21); pronotal sinus (pl. 55, fig. 73) broad, exposing spiracular sclerite; mesopleuron with speculum defined below by a more or less distinct oblique groove; postpectus not defined (pl. 52, fig. 41); basal constriction of propodeum (pl. 52, fig. 43) more or less distinctly divided into a median and two lateral foveae; tergite 2 with umbo more or less distinct (pl. 56, figs. 91, 92, 94-99); spiracles of tergite 2 distinctly basad of apical third (pl. 56, figs. 90-99); stigma triangular, tapering from radius to apex, radius at or beyond basal third (pl. 53, fig. 51); basal abscissa of radius either straight and unthickened (pl. 53, fig. 51) or thickened and curved basally (pl. 54, fig. 54), but never sinuate or thickened in middle; apical abscissa of radius (pl. 53, fig. 51; pl. 54, figs. 54, 55, 57) at most only slightly curved forward basally; fenestra not at all defined (a hairless area below base of stigma should not be confused with fenestra) (pl. 53, fig. 51; pl. 54, figs. 54, 55, 59); abscissula curved basally (pl. 53, fig. 51); nervellus broken from distinctly below middle to far above middle, upper abscissa perpendicular (pl. 54, fig. 55a) or reclivous (pl. 54, figs. 54a, 59a); scutellum not margined.--- 8
- Mandible abruptly narrowed between middle and base and so twisted that teeth are in a plane perpendicular to longitudinal axis of body, apex very narrow (pl. 50, figs. 15, 22); pronotal sinus (pl. 55, fig. 74) narrow, spiracular sclerite concealed; mesopleuron without a defined speculum; postpectus defined, the carina usually complete and closing mesosulcus (pl. 52, fig. 40); basal constriction of propodeum (pl. 52, fig. 44) undivided though sometimes coarsely foveolate; tergite 2 without umbo (pl. 56, figs. 90, 93, 100, 101); spiracles of tergite 2 at or about apical third (pl. 56, figs. 100, 101); stigma narrow with radius very near base, usually subparallel-sided beyond radius and rather abruptly tapering apically (pl. 53, fig. 52); basal abscissa of radius more or less thickened to beyond middle and usually more or less sinuate or undulant (pl. 53, fig. 52; pl. 54, figs. 61, 62; pl. 55, figs. 63-70); apical abscissa of radius (pl. 53, fig. 52; pl. 54, figs. 53, 56, 58, 60) strongly curved forward basally, then decurved to apex; fenestra (pl. 53, fig. 52; pl. 54, figs. 61, 62; pl. 55, figs. 63-70) present, with or without scleromes; abscissula straight (pl. 53, fig. 52); nervellus broken below (rarely at) middle, upper abscissa inclivous to perpendicular; scutellum margined, usually to apex.----- 22

8. Basal abscissa of radius straight, not thickened basally..... 9  
Basal abscissa of radius curved and thickened basally (pl. 54, figs. 54, 55, 59)..... 16
9. Mouth parts normal, maxillae and labium not abnormally long..... 10  
Mouth parts anthophagous, both maxillae and labium abnormally long (pl. 50, figs. 26-28)..... 15
10. Stigma triangular, radius at or beyond basal third; apical joint of front tarsus normal, not emarginate on outer side..... 11  
Stigma very long and subparallel-sided for much of its length, radius nearly at base (pl. 54, fig. 57); apical joint of front tarsus (at least in female) with a deep, rounded emargination on lower outer margin (pl. 55, fig. 75)..... 12. **Ophiogastrella** Brues
11. Scutellum, metapleuron, and subalar tubercle not inflated..... 12  
Scutellum, metapleuron, and subalar tubercle inflated (pl. 52, fig. 45).  
11. **Australophion** Morley
12. Occipital carina distinct and complete (pl. 50, fig. 14)..... 13  
Occipital carina lacking (pl. 50, fig. 12)..... 10. **Alophophion**, new genus
13. Discocubitus ascending so close to radius that discocubital cell is much narrower at that point than at second recurrent, strongly curved both above and below ramellus, which is very long and clavate (pl. 55, fig. 71)..... 8. **Rhopalophion** Seyrig  
Discocubitus various in form, but not as described above..... 14
14. Mandible abruptly rectangular at apex, teeth indicated only by a broad, deep longitudinal furrow; tergite 1 only as long as coxa plus trochanter, postpetiole as long as petiole; tergite 2 without lateral foveae at base.  
9. **Apatophion** Shestakov  
Mandible with distinct teeth apically; tergite 1 longer than coxa plus trochanter, postpetiole shorter than petiole; tergite 2 with lateral foveae at base.  
7. **Ophion** Fabricius
15. Lobes of ligula only moderately elongate, spatulate (pl. 50, fig. 26); ovipositor long, slender, recurved, sheath fully as long as first segment of abdomen (pl. 56, fig. 91); temples narrow, receding (pl. 50, fig. 26).  
13. **Potophion**, new genus  
Lobes of ligula extremely long and slender, nearly or quite as long as thorax (pl. 50, fig. 28); ovipositor stout, not exerted (pl. 56, fig. 98); temples very broad, buccate (pl. 50, figs. 11, 28)..... 14. **Agathophiona** Westwood
16. Mesosternum with a conspicuous tubercle on each side at apical third.  
15. **Eremotylus** Foerster  
Mesosternum without such tubercles..... 17
17. Eyes very shallowly emarginate (pl. 50, fig. 23); clypeus (pl. 50, fig. 23) very short, concavely truncate at apex, in profile forming a distinct angle with face, finely punctate; prepectoral carina at most faintly indicated (pl. 52, fig. 48); upper abscissa of nervellus perpendicular (pl. 54, fig. 55a).  
16. **Simophion**, new genus  
Eyes deeply emarginate (pl. 50, figs. 17-20, 24); clypeus (pl. 50, figs. 17-20, 24) less conspicuously short, truncate or arcuate at apex, in virtually same plane as face, usually coarsely punctate; prepectoral carina usually distinct; upper abscissa of nervellus usually more or less reclivous, if not the fracture is above middle (pl. 54, figs. 54a, 59a)..... 18
18. Head very thin, prolonged below eyes, mouth parts anthophagous, both ligula and lacinia abnormally long (pl. 50, figs. 14, 20, 27); hypopygium in female extending far beyond apical tergite, the ovipositor when sheathed directed dorsocephalad (pl. 56, fig. 99)..... 17. **Trophophion**, new genus

- Head neither abnormally thin nor abnormally prolonged, mouth parts normal, not anthophilous; hypopygium of normal form (pl. 56, figs. 95, 96) ---- 19
19. Nervellus broken at or below middle (pl. 54, fig. 54); abdomen not unusually compressed or heavily sclerotized dorsally, not serrate in profile (pl. 56 fig. 96); clypeus short and very broadly truncate (pl. 50, figs. 17, 18) -- 20
- Nervellus broken far above middle (pl. 54, fig. 59); abdomen very strongly compressed along dorsal margin, serrate in profile, middle tergites being creased and more heavily sclerotized medially and with prominent apices (pl. 56, figs. 95, 97); clypeus large and long (pl. 50, figs. 19, 24)----- 21
20. Postpectus defined, mesosulcus closed (pl. 52, fig. 42).
18. **Clistorapha**, new genus
- Postpectus not defined, mesosulcus open----- 19. **Boethoneura**, new genus
21. Apical margin of clypeus very broadly truncate, labrum broadly exposed (pl. 50, fig. 24); lower margin of mandible evenly curved (pl. 50, fig. 24); legs and antennae stout----- 20. **Genophion** Felt
- Apical margin of clypeus arcuate or, rarely, narrowly truncate medially, labrum narrowly exposed (pl. 50, fig. 19); lower margin of mandible bent at the middle, straight before and beyond bend (pl. 50, fig. 19); legs and antennae slender----- 21. **Chilophion**, new genus
22. Occipital carina absent (pl. 50, fig. 13); mandible very small, so twisted that upper tooth appears to be on inner margin (pl. 50, fig. 15); scutellum not margined laterally; mesopleuron with a distinct longitudinal furrow from fovea to top of prepectus (pl. 52, fig. 49); stigma extremely narrow, tapering from radius, which is very near base (pl. 54, figs. 53, 58); basal abscissa of radius thick and curved basally, apical abscissa strongly curved forward at base (pl. 54, figs. 53, 58), abscissula slightly thickened and weakly curved basally; apical joint of trochanter in middle and hind leg with a sharp, decurved tooth on outer apical margin (pl. 55, fig. 83)----- 23
- Occipital carina present; differing also from most of the other characters above----- 24
23. Postpectus completely defined; nervulus postfurcal; postnervulus broken shortly above middle; nervellus broken at about middle; epipleura of segment 2 distinctly separated from tergite throughout.
22. **Stauropactonus** Brauns
- Postpectus not defined; nervulus antefurcal to interstitial; postnervulus broken far above middle; nervellus broken far below middle; epipleura of segment 2 separated from tergite only basad of spiracles and there weakly so----- 23. **Aulophion**, new genus
24. Spiracles of tergite 2 at, before, or somewhat behind middle, but always basad of apical third (pl. 56, figs. 90, 93); stigma elongate triangular; basal abscissa of radius neither thickened nor sinuate; no fenestra; second discoidal cell pointed or very narrow at base; first abdominal segment stout (pl. 56, figs. 90, 93); ocelli small----- 25
- Not agreeing entirely with above----- 26
25. Postpectoral carina complete, mesosulcus closed; first abdominal segment very short and broad, sternite not nearly reaching spiracles, tergite 2 with spiracles distinctly basad of middle; ovipositor not exerted (pl. 56, fig. 98).
24. **Banchogastra** Ashmead
- Postpectoral carina obsolete, mesosulcus open; metapleuron tumid; first abdominal segment more slender, sternite reaching spiracles, tergite 2 with spiracles at or beyond middle; ovipositor strongly exerted (pl. 56, fig. 90).
25. **Pycnophion** Ashmead

26. Claw of hind tarsus with pecten extending beyond apex (pl. 55, fig. 77); mandible gradually narrowed from base to apex; penultimate hook of frenulum usually very different from others (pl. 54, fig. 56c); (abscissula strongly curved basally [pl. 54, fig. 56b]; a hairless area below stigma but no well-defined fenestra [pl. 54, fig. 56])..... 26. *Spilophion* Cameron  
Claw of hind tarsus normal (pl. 55, fig. 80); mandible usually abruptly narrowed; penultimate hook of frenulum normal..... 27  
27. Stigma broad with radius near middle, basal abscissa of radius not thickened; no fenestra (pl. 54, fig. 60); abscissula curved, nervellus broken at middle, upper abscissa perpendicular..... 27. *Abanchogastra* Perkins  
Stigma narrow with radius near base; basal abscissa of radius more or less thickened; fenestra distinct, with or without scleromes (pl. 53, fig. 52; pl. 54, figs. 61, 62; pl. 55, figs. 63-70); abscissula straight; nervellus broken below middle, upper abscissa usually inclivous. 28. *Enicospilus* Stephens

### 1. Genus *THYREODON* Brullé

PLATE 49, FIGURE 1; PLATE 51, FIGURES 29, 32; PLATE 52, FIGURES 38, 47;  
PLATE 53, FIGURE 50; PLATE 55, FIGURES 72, 84; PLATE 56, FIGURE 86

*Thyreodon* BRULLÉ, Histoire naturelle des insectes, Hyménoptères, vol. 4, p. 150, pl. 42, fig. 3, 1846.—SZÉPLIGETI, in Wytzman, Genera insectorum, fasc. 34, p. 25, 1905.—HOOKER, Trans. Amer. Ent. Soc., vol. 38, p. 106, 1912.—MORLEY, A revision of the Ichneumonidae based on the collection in the British Museum (Natural History), pt. 1, p. 7, 1912.—ENDERLEIN, Zool. Anz., vol. 39, p. 626, figs. 1-4, 6, 1912. [Genotype: *Thyreodon cyaneus* Brullé. By designation of Hooker, 1912.]

*Oleter* SHESTAKOV, Konowia, vol. 5, p. 259, 1926. [Genotype: (*Oleter sclenaction* Shestakov) = *Thyreodon laticinctus* Cresson.] Monobasic.

A genus of very large species, exclusively American and largely tropical in distribution. I have listed above only the more significant contributions to literature on the genus.

Head (pl. 51, fig. 32): Narrower than thorax; temples buccate to receding; occipital carina usually not reaching hypostomal carina, genae broad below; eyes rather small, moderately emarginate opposite antennae; malar space half or more as long as basal width of mandible; ocelli very small, removed from the eyes by more than their diameter; frons with deep antennal scrobes bounded medially by a prominent interantennal ridge and laterally by carinae along the eyes, the carinae usually turning away from the eye margins above toward the lateral ocelli; face moderately convex; clypeus not distinctly separated, long, pointed at apex and in profile with apex recurved, foveae very large and deep; labrum concealed; mandible broad and short, strongly narrowed from base to apex, not strongly twisted, teeth subequal; trophi of normal length; second joint of maxillary palpus flat, triangular; antenna shorter than body, rather stout, subsetiform, scape very short and squarely truncate at apex.

Thorax: Stout; pronotum with a deep transverse foveolate furrow dorsally, bounded posteriorly by a high ridge and anteriorly by the

recurved margin; pronotal sinus (pl. 55, fig. 72) broad, exposing the spiracular sclerite; mesoscutum precipitous anteriorly, notaulices more or less distinct, broad, usually foveolate or rugose; scutellum short, precipitous apically, basal fovea and lateral areas very deep, lateral carina high, extending at most to top of apical slope; prepectoral carina (pl. 52, figs. 38, 47) ascending well up on mesopleura, where it frequently bends abruptly toward, and usually reaches anterior margin; postpectoral carina (pl. 52, fig. 38) distinct only medially, where it is sometimes represented only by a tubercle on each side of mesosulcus; metapleuron (pl. 51, fig. 29) small, triangular, flat, deeply inset; propodeum (pl. 51, fig. 29) bulbous, without carinae, precipitous apically, basal constriction (pl. 51, fig. 29) very deep and narrow, spiracles very long, situated near bottom of constriction. Wings (pl. 53, fig. 50) densely hairy, with neither a hairless area below base of stigma nor a fenestra; stigma extremely narrow, no broader than combined costa and subcosta, radius very close to base, stigma very gradually tapering from radius and merging imperceptibly with metacarpus; radial cell very narrow; basal abscissa of radius neither strongly thickened nor curved, apical abscissa a long sigmoid curve; basal abscissa of radius, intercubitus and apical abscissa of cubitus forming a nearly straight line, only slightly angled at the nodes; basal vein straight or slightly decurved at lower end; discocubitus curved, without ramellus; intercubitus as long as or longer than second abscissa of cubitus; discoidal cell not or barely as long as brachial cell; lower apical angle acute; postnervulus broken above middle; nervellus from shortly antefurcal to shortly postfurcal; frenulum with many widely separated and frequently unevenly spaced hooks and extending from near radius about halfway to apex of wing; abscissula straight or weakly curved, cubitella usually not nearly reaching margin of wing; nervellus strongly reclivous, broken far above middle, upper abscissa strongly inclivous. Legs short, hind leg not or barely as long as abdomen; hind coxa (pl. 51, fig. 29) not extending beyond apex of propodeum; front and middle coxae each with a more or less tubercle-like extension below articulation of trochanter; claws moderately curved, pectination short and dense.

Abdomen (pl. 56, fig. 86): More than twice as long as head and thorax, strongly compressed beyond first segment; first segment slender, spiracle at about apical fifth, petiole usually compressed, postpetiole short, convex above; tergite 2 much shorter than tergite 1 and longer than 3, without an umbo, spiracles beyond middle but before apical third, gastrocoeli nearer to spiracles than to base, epipleura not at all separated from tergite; sternite 2 reaching to about middle of tergite 2, sternite 3 not or barely reaching apex of tergite 2; tergite 3 with a distinct, subcircular gastrocoelus-like area at extreme

base on each side; middle tergites not emarginate medially; ovipositor not exerted; male hypopygium with apex arcuate or medially emarginate, paramere (pl. 55, fig. 84) acutely pointed at apex and frequently subapically angulate on lower margin.

This genus, containing about 30 species, is divisible into two fairly distinct groups, one including the genotypes of both *Thyreodon* and *Oleter*, characterized by small head, sloping temples, more distinct notaulices, frequently with prominent rugae at their anterior ends, and slenderer habitus; and the other consisting of *T. atricolor* (Olivier), *grandis* Cresson, *fernaldi* Hooker, and their relatives with larger head, broader temples, obsolescent notaulices and stouter habitus. These appear to be all characters of specific rather than generic significance.

## 2. Genus *ATHYREODON* Ashmead

PLATE 51, FIGURE 33; PLATE 52, FIGURE 37; PLATE 56, FIGURE 87

*Athyreodon* ASHMEAD, Proc. U. S. Nat. Mus., vol. 23, p. 87, 1900.—HOOKER, Trans. Amer. Ent. Soc., vol. 38, p. 100, 1912. [Genotype: (*Athyreodon thoracicus* Ashmead) = *Athyreodon atriventris* (Cresson), according to Hooker, 1912.] Monobasic.

*Tipulophion* KRIECHBAUMER, Zeitschr. Hym. Dip., vol. 1, p. 75, 1901.—SCHULZ, Zeitschr. Hym. Dip., vol. 3, p. 252, 1903; Spolia hymenopterologica, p. 97, 1906. [Genotype: (*Tipulophion gigas* Kriechbaumer) = *Athyreodon atriventris* (Cresson), according to Hooker, 1912.] Monobasic.

*Macrophion* SZÉPLIGETI, in Wytsman, Genera insectorum, fasc. 34, p. 32, 1905.—SCHMIEDEKNECHT, Opuscula ichneumonologica, fasc. 18, p. 1420, 1908.—MORLEY, A revision of the Ichneumonidae based on the collection in the British Museum (Natural History), pt. 1, p. 14, 1912. [Genotype: (*Macrophion ornatus* Szépligeti) = (*Thyreodon*) *Macrophion grenadensis* (Ashmead), according to Morley, 1912. By designation of Viereck, Proc. U. S. Nat. Mus., vol. 42, p. 640, 1912.]

Hooker seems to have been correct in synonymizing the genotypes of *Athyreodon* and *Tipulophion* with *atriventris* (Cresson), and there appears little doubt that both *Macrophion ornatus* Szépligeti and *Thyreodon grenadensis* are also *atriventris*.

This genus, also Neotropical, is closely related to *Thyreodon*, from which, in the species that resemble *Thyreodon* most closely, it is rather weakly separated. With the acquisition of more material it may be found necessary to synonymize it with *Thyreodon*, but on the basis of the 9 or 10 species available to me it is distinguishable as follows:

Head (pl. 51, fig. 33): Temples usually very narrow and genae narrow below, rarely both broad; eyes larger, more deeply emarginate; malar space usually very short, rarely as in *Thyreodon*; ocelli large, ocellocular space frequently obsolete and rarely as long as diameter of an ocellus; antennal scrobes small and poorly defined; clypeus sharply rounded but not angulate at apex; second joint of maxillary palpus inflated.

Thorax (pl. 52, fig. 37): Propodeum usually not distinctly inflated, not reaching apex of hind coxa, basal constriction less deep and metapleuron not so deeply inset, rarely approaching the condition in *Thyreodon*. Wings with discoidal cell usually longer than, rarely equal in length to, brachial cell, lower apical angle nearly or quite a right angle; frenulum shorter than in *Thyreodon*, hooks fewer and more closely spaced; cubitella reaching wing margin; nervellus frequently not broken, the brachiella originating at its upper end. Hind leg longer than abdomen, coxa extending beyond apex of propodeum by nearly half the length of coxa; front coxa only slightly, middle coxa not at all tuberculate apically.

Abdomen (pl. 56, fig. 87): Petiole usually terete; sternite 2 not reaching middle of tergite 2, sternite 3 not reaching apex of tergite 2.

The critical characters of this genus are the inflated second joint of the maxillary palpus, the large ocelli and the extension of the hind coxae beyond the propodeum.

### 3. Genus RHYNCHOPHION Enderlein

PLATE 50, FIGURE 25; PLATE 51, FIGURES 31, 35; PLATE 52, FIGURE 39; PLATE 55, FIGURES 76, 85; PLATE 56, FIGURE 88

*Rhynchophion* ENDERLEIN, Zool. Anz., vol. 39, p. 630, figs. 5, 7, 8, 1912. [Genotype: *Rhynchophion odontandroplox* Enderlein.] Monobasic.

A third American genus of the *Thyreodon* group, anomalous in the anthophagous trophi and the entire lack of the postpectoral carina, and differing from *Thyreodon* otherwise as follows:

Head (pl. 50, fig. 25; pl. 51, fig. 35): Broader across temples than across eyes; eyes smaller than in *Thyreodon* and only arcuately emarginate, malar space longer; antennal scrobes shallow and not carinately defined; mandible longer, subparallel-sided, lower tooth the larger; trophi anthophagous, both labium and maxillae unusually long; second joint of maxillary palpus slender, terete; scape somewhat obliquely truncate.

Thorax: Pronotum with only a shallow groove dorsally, posterior and anterior margins not at all elevated; notaulices obsolete; mesopleuron with a broad longitudinal impression at level of fovea; prepectoral carina (pl. 52, fig. 39) developed only ventrally; postpectoral carina not at all indicated medially; metapleuron (pl. 51, fig. 31) large, subovate, convex; propodeum (pl. 51, fig. 31) not at all inflated, basal construction shallow medially, spiracles situated behind constriction. Wings very densely clothed with long, recumbent hair; lower apical angle of discoidal cell right or slightly obtuse; frenulum short, hooks closely and evenly spaced. Legs rather slender, hind leg much longer than abdomen; front and middle coxae not at all tuber-

culate apically; hind coxa (pl. 51, fig. 31) extending nearly its entire dorsal length beyond apex of propodeum.

Abdomen (pl. 56, fig. 88): Not or barely twice as long as combined head and thorax, very strongly compressed and, in side view, very deep; first segment rather stout, slightly decurved, postpetiole not bulbous, spiracles shortly behind apical third; tergite 2 shorter than 3, spiracles at about middle, gastrocoeli near base; sternite 2 reaching apex of tergite 1, sternite 3 to apex of tergite 2; male hypopygium broad, apex deeply emarginate on each side of middle and with a median acute tooth, paramere (pl. 55, fig. 85) rounded at apex.

This genus apparently includes comparatively few species, of which only two besides the genotype are described. It is largely tropical in its range but extends into the southwestern part of the United States.

#### **RHYNCHOPHION ODONTANDROPLAX Enderlein**

*Rhynchophion odontandroplox* ENDERLEIN, Zool. Anz., vol. 39, p. 630, figs. 5, 7, 8, 1912.

I have identified as this species a female from São Paulo, Brazil, in the collection of Henry K. and Marjorie C. Townes, which agrees almost perfectly, except in sexual characters, with the original description. The clypeus in this species, while of the same type as in the other species, is somewhat truncate medially.

#### **RHYNCHOPHION FLAMMIPENNIS (Ashmead), new combination**

*Thyreodon flammipennis* ASHMEAD, Proc. California Acad. Sci., ser. 2, vol. 4, p. 125, 1894.—MORLEY, A revision of the Ichneumonidae based on the collection in the British Museum (Natural History), pt. 1, p. 12, 1912.—HOOKER, Trans. Amer. Ent. Soc., vol. 38, p. 129, 1912.

The range of this species, originally described from Baja California, Mexico, is shown to extend from Ecuador to the southwestern United States by the following specimens in the United States National Museum: One male, Posorja, Ecuador, F. Campos R.; one female, Tlahuililo, Durango, Mexico, A. Busck; one female, two males, Douglas, Ariz., August 22, 1932, and August 2, 1933, W. W. Jones, and one female, August 20, 1932, collector unknown; one female, Tucson, Ariz.; and one female, northern New Mexico, A. O. Weese.

#### **RHYNCHOPHION LIGULIFER (Morley), new combination**

*Thyreodon ligulifer* MORLEY, A revision of the Ichneumonidae based on the collection in the British Museum (Natural History), pt. 1, p. 9, 1912.

Morley's description of the elongate trophi, the less inflated and less deeply constricted propodeum, and the more prominent coxae leaves no doubt that this species belongs in *Rhynchophion*. Morley overlooked the same characters in *flammipennis*, which he discussed on a later page of the same work.



4. Genus *AGLAOPHION* Cameron

PLATE 51, FIGURES 30, 34; PLATE 52, FIGURES 36, 46; PLATE 56, FIGURE 89

?*Dictyonotus* KREICHBAUMER, Zool. Jahrb. Syst., vol. 8, p. 197, 1894. [Genotype: *Ophion* (*Dictyonotus*) *melanarius* Kreichbaumer.] Monobasic.

*Aglaophion* CAMERON, Journ. Straits Branch Roy. Asiatic Soc., No. 39, p. 131, 1903.—MORLEY, A revision of the Ichneumonidae based on the collection in the British Museum (Natural History), pt. 1, p. 15, 1912. [Genotype: *Aglaophion flavinervis* Cameron.] Monobasic.

*Hybopleurax* ENDERLEIN, Zool. Anz., vol. 39, p. 624, 1912. [Genotype: *Hybopleurax sumatranum* Enderlein.] Monobasic. New synonymy.

*Coracophion* SHESTAKOV, Konowia, vol. 5, p. 261, 1926. [Genotype: *Coracophion manganicolor* Shestakov.] Monobasic. New synonymy.

This genus is the Old World representative of the *Thyreodon* group. It is restricted in distribution to the eastern part of the Palearctic region and the Oriental region.

I have not seen the genotype of *Aglaophion* but believe I am correct in transferring it to the genus *Thyreodon purpurascens* Smith, as which I have identified certain specimens in the United States National Museum from China and Japan. As *Hybopleurax sumatranum* Enderlein I have identified a specimen in the United States National Museum, and on this basis synonymize *Hybopleurax* with *Aglaophion*. These two are the only described species I know, aside from the genotype, that are referable to the genus. The possible synonymy of this genus with *Dictyonotus* Kriechbaumer is discussed under the latter genus.

From the other genera of the *Thyreodon* group this genus may at once be distinguished by its complete and high postpectoral carina (pl. 52, fig. 36) and deeply emarginate tergites. From the above description of *Thyreodon* it also differs as follows:

Head (pl. 51, fig. 34): About as wide as thorax; eyes more shallowly emarginate; malar space nearly as long as basal width of mandible; antennal scrobes shallow and less distinctly defined; clypeus rather distinctly separated, recurved but rounded at apex; second joint of maxillary palpus clavate.

Thorax: Pronotum not deeply grooved dorsally, neither anterior nor posterior margin prominent; mesoscutum hardly precipitous anteriorly, notaulices obsolete; mesopleuron (pl. 52, fig. 46) with a longitudinal groove or impression at top of prepectus dividing the pleuron into approximately equal upper and lower areas; sternaules obsolete; metapleuron strongly convex, frequently tuberculate; propodeum (pl. 51, fig. 30) not bulbous, basal constriction only moderately deep, spiracles situated behind constriction. Wings with lower apical angle of second discoidal cell right or slightly obtuse; frenulum much shorter and with comparatively few (about 10) hooks; cubitella nearly reaching margin of wing; nervellus broken at or near upper third. Legs

longer, hind leg much longer than abdomen; hind coxa extending about half its dorsal length beyond propodeum; front and middle coxae not produced beyond articulations of trochanters; claws more strongly curved apically, with stout, well-separated teeth.

Abdomen (pl. 56, fig. 89): Barely twice as long as head and thorax; spiracles of first segment at about apical fourth; petiole terete; tergites 3-7 emarginate medially.

**AGLAOPHION FLAVINERVIS** Cameron

As stated above, I have not seen this species, but some notes on the type supplied by Mr. Perkins should aid materially in its identification:

"Occipital carina strong and complete; ocular carina on frons distinctly raised; apical margin of clypeus outwardly reflexed; mandible similar to that of *Thyreodon*; pronotal sinus deeply emarginate; notauli absent; pit before postscutellum distinct; mesopleuron with a broad, deep, smooth, transverse furrow; sternauli very weakly indicated anteriorly; postpectoral carina very strong and complete; metapleuron weakly intumescent; propodeum about as long as broad, basal constriction very narrow, deep, partially interrupted (by becoming shallower) laterad; stigma as in *Enicospilus*; radial cell narrow and in form like that of *Thyreodon*, but a little broader, apically sharply curved to the costa; fenestra absent; basal abscissa of radius of hind wing almost straight; second tergite without umbro, spiracles beyond middle; tergites 3-5 deeply incised dorsally."

**AGLAOPHION PURPURASCENS** (Smith), new combination

*Thyreodon purpurascens* SMITH, Trans. Ent. Soc. London, p. 395, 1874.—SCHULZ, *Spolia hymenopterologica*, p. 98, 1906.—MORLEY, A revision of the Ichneumonidae based on the collection in the British Museum (Natural History), pt. 1, p. 10, 1912.—UCHIDA, Journ. Fac. Agr. Hokkaido Imp. Univ., vol. 21, p. 200, 1928; *Insecta Matsumurana*, vol. 14, pp. 43, 124, 1940.

*Ophion metallicum* RADOSZKOWSKI, Horae Soc. Ent. Rossica, vol. 21, p. 433, 1887.—SCHULZ, *Spolia hymenopterologica*, p. 97, 1906.

?*Dictyonotus melanarius* KRIECHBAUMER, Zool. Jahrb. Syst., vol. 8, p. 197, 1894. *Coracophion manganicolor* SHESTAKOV, Konowia, vol. 5, p. 261, 1926.

Uchida appears to be correct in synonymizing *Ophion metallicum* Radoszkowski and *Coracophion manganicolor* Shestakov with *purpurascens*. The doubtful synonymy of *Dictyonotus melanarius* Kriechbaumer is mine; for discussion of this see under *Dictyonotus*.

As this species I have identified the following female specimens in the United States National Museum: One, Hashimoto, Japan, June 26, 1928, T. R. Gardner; two, Gifu, Japan, Y. Nawa; one, Kuling, Kiangsi, China, N. Gist Gee; and one without locality.

J. F. Perkins examined the type and made the following notes comparing the species with *Aglaophion flavinervis*: "Differs in having the mandible in front of a line joining the base anteriorly to the V between the teeth, strongly depressed; clypeus conspicuously, though not strongly, outwardly reflexed in the apical one-third (at an angle of about 150°); ocular carina of the same form as in *Euryophion*, but the weak groove to the ocelli is not interrupted; propodeum and metapleura of the same form as in *Aglaophion*, but a little shorter, tergites 3-5 weakly excised apically."

**AGLAOPHION SUMATRANUM (Enderlein), new combination**

*Hybopleurax sumatranum* ENDERLEIN, Zool. Anz., vol. 39, p. 625, 1912.

A female captured by H. M. Pendlebury at Nakon Sri Tamarat, Khao Luang, Siam, on March 30, 1922, agrees perfectly with the description.

**5. Genus EURYOPHION Cameron**

*Euryophion* CAMERON, Ann. South African Mus., vol. 5, p. 83, 1906.—MORLEY, A revision of the Ichneumonidae based on the collection in the British Museum (Natural History), pt. 1, p. 15, 1912. [Genotype: *Euryophion nigripennis* Cameron.] Monobasic.

This African genus is unknown to me, and I should have been unable to place it without the assistance of J. F. Perkins. With this assistance I place it, I think satisfactorily, in the *Thyreodon* group, where it appears to be the South African analog of *Aglaophion*. The following description is compounded of the characters given by Cameron and Morley together with those furnished by Mr. Perkins:

Large insects, exceeding 25 mm. in length, entirely black wings.

Head: Strongly swollen behind eyes; occipital carina with a median notch directed toward the neck; frons margined by carinae both below and at sides, carina at side of frons extraordinarily raised and continued to posterior ocellus by a groove which runs from eye to front of posterior ocellus, the carina and groove interrupted shortly before ocellus by a short, deep, transverse furrow; clypeus medially reflexed and truncate; mandibles broad, not conspicuously twisted; eyes parallel and not emarginate; ocelli small; mandibles short and broad, only slightly twisted; antenna thick, tapering and about as long as forewing.

Thorax: Mesoscutum with a shallow median longitudinal furrow, notaulices obsolete; scutellum not margined; postscutellum elevated; mesosternum flat, sternaules shallow anteriorly, deep posteriorly; postpectoral carina complete, but difficult to see ventrally as it runs close to the coxae; metapleuron with a large tubercle in middle; propodeum not longer than broad, not conspicuously intumescent

basally, basal constriction very narrow. Wings with stigma and radial cell very narrow, the stigma merging imperceptibly with metacarpus, radius nearly at base; basal vein, basal abscissa of radius and abscissula somewhat thickened, apical abscissa of radius bent sharply forward apically. Legs with hind coxa extending distinctly beyond apex of propodeum; tarsal joints 1-4 compressed.

Abdomen: First segment short and broad; tergite 2 deeper than long, with epipleura extremely broad, spiracles shortly behind middle.

In making his notes on this genus Mr. Perkins did not have the genotype before him, but based his observations on the types of *Euryophion magnificus* Morley and *E. superbus* Morley, which he believed properly referred to the genus.

#### 6. Genus *ORIENTOSPILUS* Morley

*Orientospilus* MORLEY, A revision of the Ichneumonidae based on the collection in the British Museum (Natural History), pt. 1, p. 6, 1912. [Genotype: *Orientospilus individuus* Morley. By designation of Viereck, U. S. Nat. Mus. Bull. 83, p. 107, 1914.]

This genus is unknown to me. As described, it presents a confusing combination of characters. The short, tumid propodeum overlying the hind coxae suggests *Thyreodon*, the emarginate third tergite *Aglaophion*, and the fenestra *Enicospilus*; but the character that seems to ally it with any genus distinguishes it from each of the others.

Mr. Perkins examined the genotype and sent me the following notes:

"Mandible slightly twisted, but very strongly tapering, upper tooth much longer than lower; clypeus broadly, shallowly emarginate apically; pronotal sinus broad; speculum not set off; postpectoral carina absent; scutellum margined; basal constriction of propodeum deep and undivided, intumescent behind this (similar to *Thyreodon*, but laterally less sharply constricted at base); umbo present; spiracles of second tergite (which has extremely narrow epipleura) a little beyond middle; stigma as in *Enicospilus*; basal abscissa of radius thickened basally and sharply curved; apical abscissa weakly, evenly arched towards the anterior margin, fenestra absent; abscissula sharply curved at base."

It is particularly noteworthy that Perkins' observation on the lack of the fenestra is diametrically opposite that of the author of the genus, who described the fenestra as present and with scleromes.

*Enicospilus reticulatus* Cameron, 1899 (not 1902), which Morley refers to this genus differs in nearly every character from the original description of the genus. As I have identified it this species is an *Enicospilus*, anomalous only in its broad and weakly twisted mandibles. It is closely allied to *E. flavoplagiatus* Cushman.

7. Genus *OPHION* Fabricius<sup>3</sup>

PLATE 49, FIGURE 3; PLATE 50, FIGURE 21; PLATE 52, FIGURES 41, 43; PLATE 53, FIGURE 51; PLATE 55, FIGURES 73, 81; PLATE 56, FIGURE 94

*Ophion* FABRICIUS, *Entomologia systematica* . . ., Suppl., pp. 210, 235, 1798; *Systema Piezatorum*, p. 130, 1804. [Genotype: *Ichneumon luteus* Linnaeus. By designation of Curtis, *British entomology*, vol. 13, p. 600, 1836.]

*Paniscus* SCHRANK, *Fauna Boica*, p. 316, 1802. [Genotype: *Ichneumon luteus* Linnaeus.] Monobasic.

*Neophion* MORLEY, A revision of the Ichneumonidae based on the collection in the British Museum (Natural History), pt. 1, p. 30, 1912. [Genotype: *Neophion crassus* Morley. By designation of Viereck, U. S. Nat. Mus. Bull. 83, p. 100, 1914.]

To give a bibliography of this genus would be to list the works, dealing with the genus, of virtually all the more prominent students of the Ichneumonidae since the time of Gravenhorst. Suffice it here to cite a few of the more useful works for the identification of species: European species, Schmiedeknecht, *Opuscula ichneumonologica*, fasc. 4, pp. 1334-1348, 1908, and supplement, fasc. 24, pp. 24-47, 1935. American species, Hooker, *Trans. Amer. Ent. Soc.*, vol. 38, pp. 21-50, 1912. Species of the world as represented in the British Museum of Natural History, Morley, A revision of the Ichneumonidae based on the collection in the British Museum (Natural History), pt. 1, pp. 53-66, 1912. Eastern Asiatic species, Uchida, *Journ. Fac. Agr. Hokkaido Imp. Univ.*, vol. 21, pt. 2, pp. 204-211, 1928. New Neotropical species, Szépligeti, *Ann. Mus. Nat. Hungarici*, vol. 4, p. 133, 1906. Central American species, Cameron, *Biologia Centrali-Americana, Hymenoptera*, vol. 1, p. 293, 1906. The keys in these works fall far short of including all the described species, and recourse must be had to the many scattered descriptions of species.

Under strict interpretation of the International Code of Zoological Nomenclature, *Paniscus* Schrank is isogenotypic, and therefore synonymous, with *Ophion* Fabricius. Believing, however, that stability of the nomenclature of the genera involved would be best served by the preservation of the names in their traditional senses, I some years ago<sup>4</sup> attempted, I fear rather unsuccessfully, to show that Schrank's conception of *Paniscus* was based on the excellent figures in DeGeer's "*Memoires pour Servir a l'Histoire des Insectes*," 1771, which almost certainly illustrate the insect long known as *Paniscus cephalotes* Holmgren. The alternative was to synonymize *Paniscus* with *Ophion* and substitute for *Paniscus* in the traditional

<sup>3</sup> Since this synonymy was written Dr. Henry K. Townes has published his monumental "A Catalogue and Reclassification of the Nearctic Ichneumonidae" (*Mem. Amer. Ent. Soc.*, No. 11, 1944-45), on p. 730 of which, in addition to the synonyms listed here, he also synonymizes *Genophion* Felt and *Ophlogastralla* Brues. In my opinion the venational characters by which I have separated these two genera from *Ophion* are of much more than specific significance.

<sup>4</sup> *Proc. U. S. Nat. Mus.*, vol. 64, art. 20, p. 21, 1924.

sense *Netelia* Gray. The last-mentioned name is monobasic, with *Paniscus inquinatus* Gravenhorst as type, and was originally defined by the single character of the number of hooks in the frenulum. This species has not otherwise been recognized since its description in 1829, and the correctness of the identification of Gray's specimen is extremely doubtful. Townes, in 1938,<sup>4</sup> synonymized *Paniscus* Schrank with *Ophion* and used *Netelia* Gray for *Paniscus* of authors. Although I feel that this action was too precipitate and will perhaps not receive the support and following of a majority of the contemporary specialists on the Ichneumonidae, his action seems to have blocked the preservation of *Paniscus* in the sense sanctioned by well over a hundred years of usage, and I shall follow him in the use of *Netelia*. There is, however, still the threat of instability in the nomenclature of the genus if the type of *Paniscus inquinatus* Gravenhorst is still in existence, for there is no assurance that examination of the type will show it to be congeneric with the species now to be known as *Netelia*, especially those of the subgenus *Netelia* as identified by Townes.

*Ophion* is a genus of world-wide distribution and contains many hundreds of species differing widely among themselves but each possessing virtually all the characters in the foregoing key that apply to the *Ophion* group of genera. In this somewhat heterogeneous assemblage are included a number of groups of species which are more or less well distinguished from the general mass of more typical forms but are not, I think, generically distinct. Such species as *bifoveolatus* Brullé, *coloradensis* (Felt), *slossonae* Davis, and others in the North American fauna are representatives of such groups, and one is perhaps justified in suspecting that some of the generic names that have been proposed apply to such groups. It may be possible and advisable to employ some of these names, and others not yet proposed, in the subgeneric sense.

The synonymy of *Neophion* Morley is on the authority of J. F. Perkins, who examined the type of *N. crassus* Morley and pronounced it a species of *Ophion*.

The genus is characterized as follows:

Head (pl. 50, fig. 21): Various in form, but always with trophi normal, with none of the elements greatly elongate; mandible gradually narrowed from base to apex and not conspicuously twisted, teeth equal or lower tooth the longer; clypeus truncate or broadly arcuate at apex; occipital carina distinct.

Thorax: Pronotal sinus (pl. 55, fig. 73) broad, exposing spiracular sclerite; notaulices more or less distinct at least anteriorly; mesopleuron with speculum distinct; prepectoral carina (pl. 52, fig. 41)

<sup>4</sup> *Lloydia*, vol. 1, pp. 108-221, 1938.

present; postpectus not defined; scutellum, subalar tubercles, and metapleura more or less convex but not inflated; scutellum rarely completely margined; propodeum (pl. 52, fig. 43) excarinate to completely areolated, not produced over hind coxae, basal constriction neither especially deep nor especially long, divided into a median and two lateral foveae; frenum much shorter medially than basal area. Wings (pl. 53, fig. 51) without fenestra or scleromes, though frequently with a hairless area below base of stigma; stigma elongately triangular, tapering evenly from radius to apex, radius at or beyond basal third; basal vein and basal portion of discocubitus usually convergent toward anterior margin; basal abscissa of radius straight, not thickened basally, apical abscissa sinuous or straight, rarely curving forward at base; abscissula curved basally; nervellus broken from slightly below to distinctly above middle, upper abscissa perpendicular. Legs stout to very slender; apical joint of front tarsus and all claws (pl. 55, fig. 81) normal in form.

Abdomen (pl. 56, fig. 94): Tergite 2 with umbo distinct, spiracles at or near middle, rarely far before or distinctly behind middle, epipleura distinctly separated throughout; ovipositor not exerted.

#### 8. Genus RHOPALOPHION Seyrig

##### PLATE 55, FIGURE 71

*Rhopalophion* SEYRIG, Mus. Nat. Hist. Nat., Mission Scientifique de l'Omo, vol. 3, Zool., fasc. 18, Hym. 2, Ichneumonidae, p. 49, 1935. [Genotype: *Rhopalophion curvus* Seyrig.] Monobasic and designated.

Described from four African species, only one of which is named. This genus is, I think, not distinct from *Ophion*, though lacking a specimen I prefer not to synonymize it. The most conspicuous character and the one on which the genus was principally founded, the course of the discocubitus (pl. 55, fig. 71), is very doubtfully of generic significance. The one character mentioned that deters me from synonymizing the genus is described as follows: "2e abscisse radiale des ailes postérieures droites ou très légèrement sinuée (contrairement au genre *Ophion* où elle est fortement recourbée à la base)." It seems probable, since the second abscissa of radiella in *Ophion* is always straight, that the "2" is a typographical error for "1" and that the description applies to the abscissula, which, in *Ophion*, is more or less distinctly curved basally. The form of the mandible, as described, and of the stigma and basal abscissa of radius and the lack of the fenestra as shown in the figure of the wing, indicate close relationship to *Ophion*.

9. Genus APATOPHION Shestakov <sup>1a</sup>

*Apatophion* SHESTAKOV, Konowia, vol. 5, p. 262, 1926.—MEYER, Konowia, vol. 16, p. 18, 1937. [Genotype: *Apatophion mirsa* Shestakov.] Monobasic.

Despite the paucity of characters given in the original description that would aid in placing this genus in the foregoing key, it seems evident that it belongs in the *Ophion* group and very close to *Ophion*. In fact, Meyer treats it as a subgenus of *Ophion*, distinguishing it only by the character of the postpetiole being as long as the petiole. Meyer is probably correct in this treatment.

The genus should be readily distinguished by the combination character of a very short first abdominal segment with the postpetiole as long as the petiole, broad temples, rather stout and basally attenuate antennae, peculiarly formed mandibles in which the teeth are separated only by a deep groove on the outer surface (this may be due to the wearing away of the teeth), exareolate propodeum, lack of foveae at the base of tergite 2, broad stigma, sinuate apical abscissa of radius. The lack of foveae at the base of tergite 2, if this implies the absence of the umbo, is very unusual for the *Ophion* group.

The genotype (from Persia) is a rather small ophionine (12 mm.), black with ferruginous markings and legs and flavous wings.

10. Genus ALOPHOPHION,<sup>1</sup> new genus

PLATE 50, FIGURE 12

Remarkable in its entire lack of the occipital carina and differing only by that character from all species of *Ophion*, this group of species should perhaps be considered only a geographical subgenus of *Ophion*. But the several species before me, all from southern South America, present such uniformity of structure as to form a compact group more conveniently treated here as a genus.

<sup>1a</sup> After this paper was sent to the printer a specimen identified by Dr. Townes as *Hellwigiella similis* Szépligeti was received from him. This specimen is certainly not referable to the same tribe as *Hellwigia* but belongs to the Ophionini. In the foregoing key to genera it runs directly to *Apatophion* Shestakov, and, despite the very evident teeth on the mandibles, I believe it belongs to that genus. At my request Dr. Townes has compared it with the original description and reports that it agrees very well, not only with the generic description but also with the description of the genotype, except in details of coloration, especially the color of the wings, which in *H. similis* are blackish and in *A. mirsa* are described as flavous.

If we accept Dr. Townes's identification of *H. similis* as correct, the following should replace "9. Genus *Apatophion* Shestakov" and its citation, and *Hellwigiella* Szépligeti should replace *Apatophion* Shestakov in the key to genera:

9. Genus HELLWIGIELLA Szépligeti

*Hellwigiella* SZÉPLIGETI, Genera Insectorum, fasc. 34, p. 23, 1905. [Genotype: *Hellwigiella nigripennis* Szépligeti. By designation of Viereck, U. S. Nat. Mus. Bull. 83, p. 67, 1914.]

*Apatophion* SHESTAKOV, Konowia, vol. 5, p. 262, 1926.—MEYER, Konowia, vol. 16, p. 18, 1937. [Genotype: *Apatophion mirsa* Shestakov.] Monobasic.

<sup>1</sup> From α-λόφος=without a ridge, in reference to the lack of the occipital carina.



In addition to the lack of the occipital carina, all the species, of which only the genotype is identified specifically, conform to the following description:

Head (pl. 50, fig. 12): Broad behind, temples nearly reaching outside tangents of eyes; stemmaticum high and sharply defined by a surrounding groove; malar space short; mandible rather long and little narrower at apex than at base; clypeus broadly truncate.

Thorax: Notaulices rather deep and foveolate anteriorly; prepectoral carina complete; scutellum not at all margined; propodeum long, in profile with a gradual, weakly convex slope. Wings with a hairless area below base of stigma; discocubitus broken but with at most a very short ramellus, basal portion nearly parallel to basal vein; second discoidal cell rather long and narrow; postnervulus and nervellus broken distinctly above middle.

Abdomen: rather slender.

*Genotype*.—*Ophion chilensis* (Spinola).

#### 11. Genus AUSTRALOPHION Morley

##### PLATE 52, FIGURE 45

*Australophion* MORLEY, A revision of the Ichneumonidae based on the collection in the British Museum (Natural History), pt. 1, pp. 4, 30, 1912. [*Genotype*: *Ophion peregrinus* Smith.] Monobasic.

I have seen no specimen of the genotype, but there appears no doubt that the species described below is properly referred to the genus. Despite the remarkable inflation of the scutellum, subalar tubercles, and metapleura, this species is hardly more than subgenerically distinct from *Ophion*. It agrees with all the key characters leading to *Ophion*.

##### AUSTRALOPHION INFLATUS, new species

*Male*.—Length 17 mm., antenna 20 mm.

Head: Temples strongly convex but not reaching outside tangents of eyes; occipital carina complete, joining hypostomal carina far above ventral articulation of mandible; ocelli not touching eyes, stemmaticum only moderately high and defined by rather weak grooves; face very little broader than frons, clypeus broadly truncate; malar space distinct but short; mandible considerably narrowing toward apex; antennae slightly longer than body and very slender, all joints much longer than thick.

Thorax (pl. 52, fig. 45): Polished, finely and sparsely punctate; notaulices broad and shallow anteriorly; scutellum high, almost hemispherical, fovea deep; frena of scutellum and postscutellum not at all foveolate; prepectoral carina complete; subalar tubercle and metapleuron very large and convex; propodeum rather short and

convex, its surface uneven but not definitely rugose, its posterior angles rather prominent with two carinae diverging backward from each. Wings with a small hairless area below base of stigma; apical abscissa of radius curving slightly forward from base; discocubitus sharply broken by a distinct ramellus, basal abscissa strongly convergent with basal vein; postnervulus broken distinctly above middle; nervellus broken slightly below middle. Legs very slender; claws (male) very densely pectinate.

Abdomen: Slender.

Brown, with legs to apices of femora concolorous, tibiae and tarsi stramineous, antennae black, and the following markings lemon yellow: inner orbits, an elongate spot in posterior orbit, a spot on lower anterior margin of pronotum, scutellum, postscutellum, tegulae, subalar tubercle, a large spot in lower posterior angle of mesopleuron, and the metapleuron; wings slightly infumate, venation dark brown, paler basally.

*Type locality*.—Egmont, New Zealand.

*Type*—U.S.N.M. No. 57603.

One male taken February 29, 1920, by R. J. Tillyard.

## 12. Genus OPHIOGASTRELLA Brues

PLATE 54, FIGURE 57; PLATE 55, FIGURE 75

*Ophiogostrella* BRUES, Ann. Ent. Soc. Amer., vol. 5, p. 201, pl. 27, fig. 1, 1912.

[Genotype: *Ophiogastrella maculithorax* Brues.] Monobasic and designated.

Through the kindness of C. T. Brues I have been able to study the two paratypes of the genotype, and one of these is now deposited in the United States National Museum.

The peculiarly formed apical joint of the front tarsus (pl. 54, fig. 57) with its notched lower outer margin and the venation of the forewing (pl. 55, fig. 75), especially the long narrow stigma with radius near base, the strongly curved apical abscissa of radius, and the very short intercubitus distinguish this genus immediately. Brues described the vertex as "not margined behind," but I find that the occipital carina, though not strong, is complete. The second discoidal cell is short and broad, with the lower posterior angle sharply acute, the base very short and the discocubitus very strongly curved, but without a ramellus; the nervulus distinctly antefurcal; the nervellus broken at about its lower third. The prepectoral carina is obsolete above and weak elsewhere. The speculum is indistinctly defined because of the very weak groove and the fact that the entire mesopleuron is polished; the scutellum is carinately margined to apex. Otherwise the genus agrees with all the key characters leading to the *Ophion* group of genera.

The genotype is the smallest (7–8 mm. long) species of the Ophionini known to me.

13. POTOPHION,<sup>1</sup> new genus

PLATE 50, FIGURE 26; PLATE 56, FIGURE 91

Essentially *Ophion* in all the group characters, this genus is remarkable for the anthophagous trophi (pl. 50, fig. 26) and exerted ovipositor (pl. 56, fig. 91). Those two characters should suffice to distinguish it. Some of the other characters mentioned in the following description of the genotype, especially the form of the head, may also be of generic significance.

*Genotype*.—*Potophion caudatus*, new species.

## POTOPHION CAUDATUS, new species

Head (pl. 50, fig. 26): About as long as broad; eyes long and narrow; combined face and clypeus much longer than broad, slightly broader than frons; temples sharply receding; occipital carina weak, especially medially and at lower extremities; cheeks and malar space very narrow; ocelli large, but not touching eyes; mandible much broader at base than at apex; trophi, especially the labium, unusually long, lobes of ligula about three times as long as broad.

Thorax: Slender; notaulices weak; scutellum not at all margined; prepectoral carina strong, complete, very strongly sinuate; postpectoral carina lacking; propodeum long, only moderately convex, with complete basal and medially interrupted apical carinae. Wings with radius at basal third of stigma, its apical abscissa gently recurved; a sharply defined hairless area below base of stigma; discocubitus sharply broken by a long ramellus, its basal abscissa strongly convergent with basal vein; lower apical angle of second discoidal cell acute, postnervulus broken a little above middle; veins of transverse brace in about the ratio of 1:2:4, abscissula long, strongly curved at base, gently sinuate beyond; nervellus broken a little below middle.

Abdomen (pl. 56, fig. 91): Strongly compressed beyond tergite 2; postpetiole depressed, more than half as long as petiole; tergite 2 with spiracles very slightly basad of middle, umbo distinct, epipleura separated throughout; ovipositor recurved, sheath about as long as first tergite.

Ferruginous, with head largely, thorax laterally, parapsidal stripes and lateral margins of mesoscutum, postscutellum, and petiole yellow; dorsal edge of abdomen somewhat brownish; sheath blackish; wings hyaline, costa and stigma yellow, other veins brown.

*Type locality*.—Mount Omei, Szechwan, China, 11,000 feet.

*Type*.—U. S. N. M. No. 57604.

Two females, both captured by D. C. Graham, the holotype in July 1936, and the paratype at 12,000 feet, 30 miles north of Tatseinlu, Szechwan, on July 9, 1923.

<sup>1</sup> From *potōs* = drinking, in reference to the long trophi.

## 14. Genus AGATHOPHIONA Westwood

PLATE 50, FIGURES 11, 28; PLATE 56, FIGURE 98

*Agathophiona* WESTWOOD, Tijdschr. Ent., vol. 25, p. 20, pl. 4, figs. 5-13, 1882.—CAMERON, Biologia Centrali-Americana, Hymenoptera, vol. 1, p. 297, pl. 12, fig. 11, 1886.—ASHMEAD, Proc. U. S. Nat. Mus., vol. 23, p. 87, 1900.—SCHMIEDEKNECHT, Opuscula ichneumonologica, fasc. 18, p. 1419, 1908. [Genotype: *Agathophiona fulvicornis* Westwood.] Monobasic.

An anomalous genus, in respect to both the mouth parts and the abdominal structure, but exhibiting most of the characters of the *Ophion* group.

Head (pl. 50, figs. 11, 28): Temples buccate and extending far beyond outside tangents of eyes; occipital carina distinct but not reaching hypostomal carina; eyes and ocelli small, eyes shallowly emarginate; ocellocular line and malar space distinct; clypeus deeply separated, broad, flat, broadly truncate at apex; labrum exposed; antenna stout, tapering both basally and apically, much shorter than body; mandible only slightly narrower at apex than at base, somewhat twisted, teeth bluntly rounded; trophi elongate, especially the ligula, which is prolonged into two slender processes each grooved on the inner side and fitting together to form a slender tube extending, when at rest, posteriorly to or beyond apex of propodeum, galea of maxilla elongately oval and thin, both maxillary and labial palpi very slender.

Thorax: Short-ovate; pronotum with scrobes weakly defined, pronotal sinus broad, exposing spiracular sclerite; mesoscutum precipitous anteriorly, notaulices deep but short; scutellum broad, precipitate posteriorly, margined only basally; mesopleuron and sternum convex, prepectoral carina complete, speculum defined, fovea deep, postpectus not defined; metapleuron evenly convex, lower marginal carina not especially strong; propodeum very short, precipitate and somewhat concave behind, barely overlapping hind coxae, basal carina absent, apical carina present only laterally, basal constriction indistinctly interrupted, very narrow dorsally except medially where it is in the form of a pit, frenum extremely short; spiracle large, elongate, well behind bottom of constriction. Wings densely hairy both dorsally and ventrally and without fenestra or hairless area in discocubital cell; stigma narrowly triangular, radius at about basal fourth; basal abscissa of radius not thickened, weakly curved basally, apical abscissa nearly straight; veins of transverse brace in about the proportions of 1:1.5:3; discocubitus strongly curved, usually without trace of ramellus; second discoidal cell two-thirds as broad apically as long posteriorly, posterior angle acute, base broad, the postnervulus being broken at about middle, nervulus distinctly postfurcal; abscissula strongly curved basally; nervellus broken at or

slightly above middle, reclivous, upper abscissa perpendicular. Legs stout and rather short; hind coxa rather short-ovate, flattened dorsally; hind femur little longer than combined coxa and trochanter; tibia somewhat expanded apically, inner calcarium barely half as long as basitarsus, nearly uniform in thickness and without a conspicuous fringe of long hairs along inner margin; basitarsus much shorter than other joints combined, apical joint much longer than fourth, rather slender and decurved, claws rather weakly curved, coarsely pectinate in female, closely so in male.

Abdomen (pl. 56, fig. 98): Rather weakly compressed and in profile slender; first tergite broad and stout with spiracles at about apical two-fifths, sternite barely reaching a point ventrad of spiracles; tergites 1-3 subequal in length; tergite 2 with umbo, gastrocoeli near base, indistinct, spiracles about at middle; tergite 6 in female deeply cleft medially; hypopygium in female extremely long, directed downward (in museum specimens) and wrapped around the ovipositor which is directed upward with its tip enclosed in the short sheath, which does not extend above the apical tergite, ovipositor rather long and stout with the deep round dorsal notch near the apex; male genitalia unusually long.

The genotype is the only known species. It is shining black with pale reddish antennae and tarsi and deeply infumate wings. It is known only from Mexico.

#### 15. Genus EREMOTYLUS Foerster

*Eremotylus* FOERSTER, Verh. naturh. Ver. preuss. Rheinlande, vol. 25, p. 150, 1868 (no species included).—THOMSON, Opuscula entomologica, fasc. 12, p. 1193, 1888.—BRAUNS, Arch. Ver. Freunde Naturg. Mecklenburg, vol. 43, p. 98 (1889), 1890.—SZÉPLIGETI, in Wytzman, Genera insectorum, fasc. 34, p. 35, 1905 (part).—SCHMIEDEKNECHT, Opuscula ichneumonologica, fasc. 18, p. 1450, 1908; suppl. fasc. 24, p. 49, 1935. [Genotype: *Anomalon marginatus* (Gravenhorst) Jurine. First species included.]

*Camptoneura* KRIECHBAUMER, Zeitschr. Hym. Dip., vol. 1, pp. 22, 23, 1901. [Genotype; *Anomalon marginatus* (Gravenhorst) Jurine. By designation of Viereck, U. S. Nar. Mus. Bull. 83, p. 27, 1914.] Isogenotypic with *Eremotylus* (Foerster) Thomson.

I have seen no specimen representing this genus. Certain North American species have been referred to it, but according to the descriptions by Thomson and Brauns and the additional characters communicated by J. F. Perkins such reference is incorrect. They are properly referable to *Enicospilus* despite their lack of alar scleromes.

In erecting *Eremotylus* it was Foerster's intention to include in it those species of *Ophion* in the broad sense, in which the discocubitus is unbroken and the discocubital cell lacks scleromes. In his unpublished manuscript he assigned to it *Ophion bombyciworus* Gravenhorst and *Ophion undulatus* Gravenhorst. *Ophion marginatus* he

left in *Ophion*, but from descriptions of that species it is apparent that it agrees with the original description of *Eremotylus* and can stand as the genotype.

Subsequent to its original description *Eremotylus* has had three somewhat different interpretations. The first, and the one here followed, was that of Thomson, with *Ophion marginatus* Gravenhorst as type. Ashmead (1896) gave it a second interpretation when he placed in it his *E. arctiae*, an American species of *Enicospilus* without scleromes; while Kriechbaumer referred to it *Ophion undulatus* Gravenhorst, genotype of *Allocamptus* Thomson and *Cymatoneura* Kriechbaumer on a later page of the same paper in which he had erected *Cymatoneura* for that species. The last two interpretations I consider synonymous with *Enicospilus* Stephens. Mr. Perkins writes, "the only species I recognize as belonging to *Eremotylus* is *marginatus* Grav.," and "*Camptoneura curvinervis* Kriechbaumer, I consider, belongs to a distinct genus."

The following generic description of *Eremotylus* is compiled from those by Thomson and Brauns, with several characters (indicated by quotation marks) furnished by Mr. Perkins interpolated:

Head: Temples broad; occipital carina distinct; ocelli small, not touching eyes; clypeus not separated, apex rounded; mandible stout, "not conspicuously twisted," teeth equal.

Thorax: "Pronotal sinus broad"; prepectoral carina above and notaulices obsolete; postpectoral carina absent; "speculum sharply defined below, strongly transcostate"; mesosternum with a conspicuous tubercle on each side at posterior third; scutellum acutely margined; propodeum short, basal constriction divided (Perkins says, "sharply excavated and undivided"), basal carina acutely elevated in middle, apical carina interrupted. Wings with "stigma narrowly lanceolate"; radius basally thickened and abruptly curved, "apical abscissa evenly curved"; "fenestra absent"; discocubitus not convergent with basal, ramellus absent; brachial cell not narrowed apically, upper margin straight; nervulus slightly antefurcal; postnervulus broken far above middle; abscissula strongly curved basally; nervellus broken below middle, nearly perpendicular.

Abdomen: Membrane of tergite 1 reaching spiracle of tergite 2; tergite 2 with umbo distinct and "with a deep elongate furrow on each side, which is subparallel with the lateral margin and extends to about one-half the distance from the base to the spiracle, the spiracle at middle of segment."

Such of the key characters as are included in the above description indicate that *Eremotylus* belongs in the *Ophion* group and probably near *Boethoneura*, new genus.

16. SIMOPHION,<sup>1</sup> new genus

PLATE 50, FIGURE 23; PLATE 52, FIGURE 48; PLATE 54, FIGURE 55; PLATE 56, FIGURE 92

This and the next five genera form a series separable from the rest of the *Ophion* group of genera by the form and course of the basal abscissa of radius, which is distinctly thickened at the extreme base and rather abruptly bent or curved immediately beyond the thickening, whence it is straight to the interception of the intercubitus. From all the other genera the present genus differs in the peculiar form of the clypeus, the obsolete or lacking prepectoral carina, and the weakly emarginate eyes.

Head (pl. 50, fig. 23): Thick, temples strongly convex and nearly or quite reaching outside tangents of eyes, occiput and frons not or very shallowly concave; occipital carina rather weak but complete; frontal orbits slightly tumid; eyes parallel, very weakly emarginate; stemmaticum sharply defined, ocelli not nearly touching eyes; malar space short; clypeus very short, broadly truncate, usually concavely so, at apex, protruding in such manner as to form a distinct angle with face; mandible long and narrow, lower margin bent at nearly a right angle, teeth narrow, upper one the longer; palpi very slender; antenna slender, filiform, much shorter than body.

Thorax: Pronotal sinus distinct but unusually shallow, spiracular sclerite visible; mesoscutum very strongly convex and precipitous anteriorly, notaulices obsolete or wanting; scutellum narrow, margined at most basally, its frenum and that of postscutellum shallow; prepectoral carina (pl. 52, fig. 48) very weak or absent; postpectoral carina absent; speculum defined; propodeum excarinate, basal constriction shallow. Wings (pl. 54, fig. 55) with discal ciliation short and sparse, a hairless area below stigma; stigma nearly as in *Enicospilus*, radius at about basal fourth; basal abscissa of radius thickened and curved at extreme base, apical abscissa somewhat recurved from base; basal vein decurved at base; discocubitus with first recurrent portion sinuous, cubitus portion rather strongly arched, the two portions joining in a rather sharp curve or a slight angle, sometimes with a trace of ramellus, first recurrent and basal vein nearly parallel; intercubitus half or more as long as second abscissa of cubitus; nervulus interstitial or postfurcal; postnervulus broken shortly above, nervellus shortly below, middle; frenulum short, with 6-9 slender hooks spaced rather far apart. Legs very slender; claws weakly curved, pecten (♀) with short, fine teeth.

Abdomen (pl. 56, fig. 92): Slender, tergite 1 decurved, petiole terete, postpetiole depressed; tergite 2 with distinct umbo, spiracles at or slightly beyond middle, epipleura completely separated.

<sup>1</sup> From *snubs*=snubnosed, in reference to the short, projecting clypeus

*Genotype*.—*Simophion excarinatus*, new species.

**SIMOPHION EXCARINATUS, new species**

*Female*.—Head: Temples hardly reaching outside tangents of eyes; posterior tangent of eyes bisecting posterior ocelli; malar space less than half as long as basal width of mandible; clypeus concavely truncate, more than twice as broad as long; antennae extremely slender, 45-jointed, all flagellar joints longer than thick.

Thorax: Densely and finely pubescent and laterally minutely punctate and mat, shining dorsally and ventrally; propodeum finely rugulose posteriorly, shining basally. Legs extremely slender, hind femur about 10 times as long as deep, of nearly uniform depth throughout; inner hind calcarium hardly one-fourth as long as basitarsus.

Abdomen: Polished, very minutely pubescent; tergites 2 and 3 subequal in length and nearly as long as 1, 4 and 5 subequal and fully three-fourths as long as 3, 6 two-thirds as long as 5, 7 and 8 together about equal to 6.

Dark brown; orbits so broadly yellowish white as to make the head appear largely of that color; mesoscutum somewhat darker than rest of thorax, sometimes with prescutum paler or with faint traces of parapsidal stripes; wings hyaline, stigma and veins dark brown, metacarpus, a spot at apex of costa and radices pale, tegulae stramineous.

*Type locality*.—Tempe, Ariz.

*Type*.—U. S. N. M. No. 57605.

*Paratypes*.—California Academy of Sciences; collection of Henry K. and Marjorie C. Townes.

Seven specimens, including the holotype, collected at light at Tempe, Ariz., by E. V. Walter and M. Martinez in February and March, 1923 to 1926, under Tempe No. 4916; 1 female, Gila Bend, Ariz., March 1, 1930, C. D. Lebert; 2 females, Phoenix, Ariz., 1933, R. H. Crandall; and 2 females, Needles, Calif., February-March 1922, J. A. Kuschel.

In addition to the genotype, representatives of 4 other species are before me. All are from the arid regions of the southwestern United States. All of the 40 specimens are females.

**17. TROPHOPHION,<sup>1</sup> new genus**

PLATE 50, FIGURES 14, 20, 27; PLATE 55, FIGURE 78; PLATE 56, FIGURE 99

A remarkable genus differing in many respects from the more typical genera of the *Ophion* group, notably in the form of the head, the anthophagous mouth parts, the basally curved and thickened radius and the very little compressed abdomen with the female

<sup>1</sup> From τροφή=food, in reference to the long trophi.



hypopygium elongate and protruding. In the last-mentioned character and the anthophagous mouth parts it resembles *Agathophiona*, but whereas in the latter genus it is the labium that is most highly developed, in the present genus it is the maxillae and the prolongation is much less. *Trophophion* is most closely related to *Genophion* Felt, from which it can be at once distinguished by its long thin head, subclavate antennae, the form of the abdomen, the unusually large and coarsely pectinate claws, and by many other characters mentioned in the following description.

Head (pl. 50, figs. 14, 20, 27): Extremely thin and long, occiput deeply concave; temples strongly convex; malar space very long; occipital carina fading out below and not reaching hypostomal carina; face and clypeus weakly convex, clypeus broadly truncate; labrum semicircularly exposed, maxillae and labium very long, especially the galea, palpi unusually short; mandible long and narrow, scarcely narrowed toward apex, strongly curved, only slightly twisted; eyes narrow; ocelli very small, stemmaticum not elevated and not defined by a groove; antenna much shorter than body, flagellum slender at base, gradually thicker toward apex.

Thorax: Stout; pronotum long and flat medially, with no transverse groove; pronotal sinus broad, exposing spiracular sclerite; mesoscutum moderately convex, notaulices absent; scutellum evenly convex, margined only at base; speculum weakly defined; prepectus narrow, carina obsolete above, postpectus not defined, propodeum very short, apical slope precipitous, not at all overlapping hind coxae, median and lateral foveae of basal constriction deep and widely separated. Wings with coarse veins and dense, short discal ciliation, a small hairless area below base of stigma; stigma narrowly triangular, with radius at basal third; basal abscissa of radius thickened and curved at base, apical abscissa straight; second discoidal cell short and broad, lower apical angle acute, discocubitus strongly curved; frenulum with 6 or 7 hooks; abscissula rather weakly curved at base; nervellus broken above middle, upper abscissa perpendicular to mediella. Legs very stout and short; apical tarsal joints long, claws (pl. 55, fig. 78) long and coarsely pectinate, with few teeth.

Abdomen (pl. 56, fig. 99): Weakly compressed; tergite 1 decurved; tergite 2 with umbo short and rather weakly defined, spiracles at middle; apical tergites in female deeply emarginate medially; hypopygium in female very long and protruding, ovipositor when sheathed pointing dorsocephalad.

*Genotype*.—*Trophophion tenuiceps*, new species.

**TROPHOPHION TENUICEPS, new species**

*Female*.—Length 12 mm., antenna 8 mm.

Head: More than twice as broad as thick; temple extending slightly beyond outside tangent of eye; diameter of ocellus shorter than ocellular line and hardly half as long as postocellar line; eye more than twice as long as broad, shallowly emarginate within; malar space distinctly longer than basal width of mandible; galea three times as long as broad; antenna 30-jointed, subapical joints of flagellum thicker than long and nearly twice as thick as basal joint.

Thorax: Evenly and rather densely punctate laterally (including speculum) and ventrally, more sparsely and finely so and more polished dorsally; propodeum with basal carina rather distant from base, distinct on each side of middle but fading out medially and laterally, posterior face precipitate from basal carina, surface before carina polished and punctate, apical slope indistinctly transversely rugulose with traces of apical carina laterally. Wings with basal abscissa of radius half as long as apical abscissa; veins of transverse brace in about the proportion of 2:5:6; second discoidal cell shorter than brachial cell, second recurrent more than half as long as basal abscissa of subdiscoideus; basal vein and base of discocubitus subparallel; nervulus interstitial and inclivous; postnervulus broken slightly above middle; nervellus broken at about upper third. Legs stout and short, hind femur barely reaching apex of tergite 2 and less than four times as long as deep; apical tarsal joints slender, decurved, each as long as the corresponding second joint, claw two-thirds as long as apical joint, pecten with five long, strong teeth.

Abdomen: Polished and virtually impunctate.

Bright ferruginous; wings hyaline with a brownish longitudinal stain along apical anterior margin of each and one along basal vein; venation black, costa and base of stigma yellowish; tarsal claws and ovipositor sheath black.

*Male*.—Essentially like the female, except that tergites are not emarginate.

*Type locality*.—Phoenix, Ariz.

*Holotype and allotype*.—U. S. N. M. No. 57606.

*Paratypes*.—California Academy of Sciences; Citrus Experiment Station, Riverside, Calif.; collection of Henry K. and Marjorie C. Townes.

Described from four females and two males, the holotype and male and female paratypes collected at Phoenix, Ariz., April 12, 1939, by R. H. Crandall; the allotype and a female paratype at Palm Springs, Calif., March 22, 1916, by C. L. Fox; and a female in Palm Canyon, Calif., March 25, 1933, by P. H. Timberlake.

18. CLISTORAPHA,<sup>10</sup> new genus

PLATE 50, FIGURE 18; PLATE 52, FIGURE 42; PLATE 54, FIGURE 54; PLATE 56, FIGURE 96

From all the other genera of the *Ophion* group this genus is immediately distinguishable by its possession of a complete postpectoral carina.

Head (pl. 50, fig. 18): Thick; temples strongly convex; occiput deeply concave, carina complete; eyes and ocelli large, malar space and ocellocular line much reduced, eyes deeply emarginate and nearly parallel within (rarely in species with very strongly buccate temples, the eyes and ocelli are smaller, the malar space and ocellocular line rather long, and the face is considerably broader than the frons); clypeus short, broadly truncate, coarsely punctate; labrum conspicuously protruding beyond clypeus; mandible not strongly twisted, narrow and strongly curved, little narrower at apex than at base; antenna filiform, not or barely as long as body.

Thorax: Pronotal sinus broad, spiracular sclerite exposed; meso-scutum sloping anteriorly, notaulices complete; scutellum margined at least basally; speculum distinct; prepectoral and postpectoral carinae (pl. 52, fig. 42) complete; propodeum moderately convex in profile. Wings (pl. 54, fig. 54) densely, finely pilose, with a hairless area below stigma; stigma elongate triangular, with radius at about basal third; basal abscissa of radius curved and thickened at base, apical abscissa slightly curved; discocubitus strongly curved, without ramellus, basal portion nearly parallel to basal vein; second discoidal cell much narrowed at base, its lower apical angle acute; nervulus distinctly antefurcal to shortly postfurcal; frenulum short, with only 5 or 6 hooks; abscissula curved, somewhat thickened basally; nervellus weakly broken at or below middle, upper abscissa reclivous. Legs short and rather stout, hind femur barely reaching beyond apex of tergite 2; claws closely pectinate, not more closely so in male than in female.

Abdomen (pl. 56, fig. 96): Strongly compressed, tergite 2 with spiracles shortly beyond middle, umbo distinct, epipleura separated throughout; male genitalia with paramere deep, its ventral margin evenly curved to the subacute apex.

*Genotype*.—*Ophion subfuliginosus* Ashmead.

Several other species occur in the arid southwestern United States, all undescribed.

<sup>10</sup> From *κλειστός*=closed, and *σutura*=suture, in reference to the closing of the mesoscutus by the postpectoral carina.

**CLISTORAPHA SUBFULIGINOSA** (Ashmead), new combination

*Ophion subfuliginosus* ASHMEAD, Proc. California Acad. Sci., ser. 2, vol. 4, p. 126, 1894.—HOOKER, Trans. Amer. Ent. Soc., vol. 38, p. 29, 1912. [Lectotype (hereby designated): The female specimen from El Taste, Baja California, Mexico, in the collection of the California Academy of Sciences.]

One of the El Taste cotypes of this species (a female) is in the United States National Museum and the other two and the El Chincho specimen are in the California Academy. Through the kindness of the Academy and of E. Gorton Linsley I have had the opportunity to examine the male and the female from El Taste.

In addition to the types I have seen the following specimens: One female from near San Fernando, Ariz., August 28, 1925, R. Budlong; one of each sex, St. Xavier Mission, Tucson, Ariz., July 29, 1924, E. P. Van Duzee; two females and three males, San Pedro River, Fairbanks, Ariz., September 6, 1927, J. A. Kusche; one female, Washington Mountains, near Nogales, Ariz., September 7, 1927, J. A. Kusche; Baboquivari Mountains, Ariz., September 15, 1928, O. C. Poling; three females, 30 miles east of Quijotoa, Pima County, Ariz., August 28–29, 1927, Cornell University lot No. 542 sub. 336; Cobabi Mountains, 80 miles west-southwest of Tucson, Ariz., September 3, 1921, E. R. Tinkham.

In his second reference to this species (Proc. California Acad. Sci., ser. 2, vol. 5, p. 547, 1895) Ashmead recorded two specimens, a female and a male, from San José del Cabo, Baja California. These specimens, both females though one is labeled male by Ashmead, are in the National Museum. They are misidentified and are not congeneric with *subfuliginosus*, but belong to the genotype species of the new genus *Boethoneura* described below.

**19. BOETHONEURA**,<sup>11</sup> new genus

## PLATE 50, FIGURE 17

Closely related to *Clistorapha*, but lacks the postpectoral carina. Agrees otherwise with the above description of *Clistorapha*, although the temples are narrower, the clypeus relatively longer, the stigma broader, the discocubitus more sharply curved in the middle and frequently with a trace of the ramellus.

*Genotype*.—*Boethoneura arida*, new species.

Several other species, all undescribed, occur in the arid southwestern part of the United States.

<sup>11</sup> From *strengthen*=reinforce, and *super*=nerve, in reference to the thickened base of radius.

**BOETHONEURA ARIDA, new species**

*Ophion subfuliginosus* ASHMEAD, Proc. California Acad. Sci., ser. 2, vol. 5, p. 547 1895 (not Proc. California Acad. Sci., ser. 2, vol. 4, p. 126, 1894). Misidentification. No description.

For explanation of the above citation see *Chistorapha subfuliginosus* (Ashmead).

*Female*.—Length 13 mm.

Head (pl. 50, fig. 17): Occiput deeply concave; temple rather strongly convex, but not nearly reaching outside tangent of eye; eye nearly twice as long as broad, rather shallowly emarginate; ocelli narrowly but distinctly separated from eyes; malar space short but distinct; face and clypeus nearly flat, coarsely punctate, the face more densely and finely so medially and polished and nearly impunctate laterally, the head elsewhere impunctate and polished; clypeus twice as broad as long, very broadly truncate at apex; exposed portion of labrum nearly as long as clypeus, heavily sclerotized, punctate, with long rather dense hair; mandible more than twice as long as broad basally, tapering to apex, slightly twisted, punctate; antenna slightly shorter than body  $\pm 40$ -jointed, slender, of nearly uniform diameter except for a slight apical taper.

Thorax: Stout, shining, punctate, mesoscutum less distinctly so, notaulices briefly impressed anteriorly; scutellum high, polished and sparsely punctate, margined basally, its frenum more coarsely and densely punctate; frenum of postscutellum striate; propodeum with basal carina medially and the apical carina laterally distinct, the latter sometimes complete, basal area polished and sparsely punctate, the rest of the surface finely rugoso-punctate; spiracles large, elongate reniform. Wings rather densely ciliate with bare areas below base of stigma and in base of radiellian cell; stigma narrowly triangular with radius distinctly basad of middle; thickening of basal abscissa of radius extending nearly to middle; apical abscissa slightly curved; basal vein slightly curved for most of its length with a sharper reverse curve above its junction with median vein; discocubitus bent just basad of bulla, the basal portion a weakly sigmoid curve; veins of the transverse brace about in the ratio 1:2:3; second recurrent about half as long as basal abscissa of subdiscoideus, the angle between the two veins slightly acute; nervulus interstitial to slightly antefurcal; postnervulus broken at about upper third; radiella strongly curved and somewhat thickened basally; nervellus broken at or slightly below middle, its upper abscissa distinctly reclivous; frenulum composed of 5 or 6 closely spaced hooks. Legs rather short and stout, hind femur barely reaching apex of tergite 2; claws rather coarsely pectinate.

Abdomen: Stout, hardly twice as long as head and thorax; first

segment slightly decurved, spiracle at about apical third; tergite 2 a little more than three times as long as broad at base.

Ferruginous; vertex, frons, subalar tubercles and scutellum, and sometimes the notaulices, yellowish; wings hyaline, radial cell infumate basally and along anterior margin, stigma and costa ferruginous, other veins blackish.

*Type locality*.—San José del Cabo, Baja California, Mexico.

*Holotype and paratypes*.—U. S. N. M. No. 57607.

*Paratypes*.—California Academy of Sciences; American Museum of Natural History (New York); Cornell University.

Nine females, the holotype and two others from the type locality; two from Phoenix, Ariz., April 19, 1933, R. H. Crandall; one from 14 miles east of Oracle, Ariz., July 27, 1924, J. O. Martin; Kits Peak, Rincon, Baboquivari Mountains, Ariz., August 1, 1946, 4,050 ft.; one from Congress, Ariz., May 6, 1902, Osler; one from Yerington, Lyon County, Nev., July 29, 1909. A headless male from Yerington, Nev., in the collection of Cornell University probably belongs here, but because of its poor condition it is not included in the type series.

## 20. Genus GENOPHION Felt

PLATE 50, FIGURE 24; PLATE 55, FIGURE 79; PLATE 56, FIGURE 95

*Genophion* FELT, New York State Mus. Bull. 76 (19th Rep. State Ent.), p. 123, 1904. [Genotype: (*Genophion gilletti* Felt) = *Genophion costalis* (Cresson). By original designation.]

Hooker<sup>12</sup> synonymized *Genophion gilletti* Felt with *Ophion costalis* Cresson, thereby inferentially synonymizing the genus with *Ophion* although he did not list it in the synonymy of *Ophion*. In my opinion the genus is distinct.

Head (pl. 50, fig. 24): Thick; temples strongly convex; occiput concave, carina usually complete though rarely obsolete below; eyes narrow, not bulging, shallowly, broadly emarginate; ocelli small to rather large, but never nearly touching eyes; malar space distinct, frequently very long; clypeus rather flat, large, broadly truncate, labrum prominent; mandible narrow, evenly curved, not much broader at base than at apex; antenna much shorter than body, slightly thickened before apex.

Thorax: Stout; pronotum rather long medially, with transverse groove shallow, pronotal sinus broad, exposing spiracular sclerite; mesoscutum strongly convex in profile, notaulices obsolete; scutellum large, subquadrate, strongly convex, usually margined basally; mesopleuron with speculum weakly defined; prepectoral carina strong

<sup>12</sup> Trans. Amer. Ent. Soc., vol. 33, p. 26, 1912.

though usually not quite reaching anterior margin; postpectoral carina absent; propodeum strongly convex in profile, entirely without carinae. Wings densely hairy with a hairless area below base of stigma, stigma triangular, with radius at about basal third; basal abscissa of radius thickened and curved basally, apical abscissa straight or weakly curved; discocubitus strongly curved, without ramellus, basally subparallel with basal vein; second discoidal cell narrow at base, lower apical angle acute; nervulus postfurcal; abscissula curved basally; nervellus broken far above middle, upper abscissa reclivous; frenulum very short, with only 5 or 6 hooks. Legs rather short and stout, hind femur reaching little beyond apex of tergite 2; claws (pl. 55, fig. 79) closely pectinate, no more closely so in male than in female.

Abdomen (pl. 56, fig. 97): Very strongly compressed, its upper margin serrate in profile due to the heavily sclerotized and acute apices of the compressed tergites; segments 1 and 2 stout; tergite 2 with spiracles at about middle, umbo very distinct, epipleura completely separated; male genitalia with paramere slender, its ventral margin straight basally then bent upward and rising obliquely to the acute apex.

This is another genus of the arid southwestern part of the United States, being represented there by five or six species, of which only the genotype is described.

**GENOPHION COSTALIS** (Cresson), new combination

*Ophion costale* CRESSON, Proc. Acad. Nat. Sci. Philadelphia, 1878, p. 366.—

HOOKE, Trans. Amer. Ent. Soc., vol. 38, p. 26, 1912.

*Ophion costalis* Cresson, DALLA TORRE, Catalogus hymenopterorum, vol. 3, pt. 1, p. 189, 1901.—MORLEY, A revision of the Ichneumonidae based on the collection in the British Museum (Natural History), pt. 1, pp. 58, 60, 1912.

*Genophion gilletti* FELT, New York State Mus. Bull. 76 (19th Rep. State Ent.), p. 123, 1904.

I have examined the types of both *costalis* and *gilletti* and have seen three additional specimens, a male from Colorado (C. F. Baker), a female from Boulder, Colo., June 7, 1922, about 6,650 feet (American Museum of Natural History), and a male from Mount Diablo, Calif., April 20, 1935 (G. E. and R. M. Bohart).

**21. CHILOPHION,<sup>11</sup> new genus**

PLATE 50, FIGURE 19; PLATE 54, FIGURE 59; PLATE 55, FIGURE 82; PLATE 56, FIGURE 97

Most closely related to *Genophion* in the basally bent and curved radius, in the strongly reclivous nervellus with the fracture far above middle and the upper abscissa also reclivous and in the serrate abdomen; but differing in the form of the clypeus, which is thick, flat, and

<sup>11</sup> From *χείλος* = lip, in reference to the large clypeus.

apically arcuate, the long, slender legs and antennae and in some of the other characters detailed in the following description:

Head (pl. 50, fig. 19): Thick; temples strongly convex but not especially broad; occiput concave, carina complete; eyes rather narrow, not bulging, broadly emarginate; ocelli rather large, but not contiguous with eyes, stemmaticum prominent and sharply defined by grooves; malar space distinct but not long; clypeus large, thick, flat, apex broadly arcuate, labrum very narrowly exposed; mandible rather long and narrow, its lower margin sharply curved in middle; antenna slender, filiform.

Thorax: Rather slender, pronotal sinus broad, exposing spiracular sclerite; mesoscutum moderately convex in profile, notaulices obsolete; scutellum subtriangular, strongly convex, not margined; speculum defined; prepectoral carina distinct except at upper end and rarely obsolescent throughout; postpectoral carina absent; propodeum weakly convex in profile, entirely without carinae. Wings (pl. 54, fig. 59) rather sparsely hairy, a hairless area below base of stigma; stigma elongate triangular, radius at or slightly basad of basal third; basal abscissa of radius thickened and curved at base, apical abscissa somewhat curved; basal vein rather strongly decurved at lower end; nervulus postfurcal; second discoidal cell rather long, its lower apical angle acute, base not especially narrow; discocubitus straight basally, curved apically, without ramellus, basal portion nearly parallel with basal vein; frenulum very short, with 6 or 7 hooks; abscissula curved basally; nervellus broken far above middle, upper abscissa reclivous. Legs slender; claws (pl. 55, fig. 82) rather closely pectinate.

Abdomen (pl. 56, fig. 97): Slender basally, strongly compressed beyond tergite 2, serrate in profile, the compressed tergites heavily sclerotized along dorsal margins and acute at apices.

*Genotype*.—*Ophion abnormis* Felt.

Another genus of the arid southwestern part of the United States, whence I have seen several species, of which only the genotype is described.

**CHILOPHION ABNORMIS (Felt), new combination**

*Ophion abnormum* FELT, New York State Mus. Bull. 76 (19th Rep. State Ent.), p. 121, pl. 2, fig. 5, 1904.

*Erymotylus felti* VIERECK, Trans. Kansas Acad. Sci., vol. 19, p. 312, 1905.

*Ophion abnormis* HOOKER, Trans. Amer. Ent. Soc., vol. 38, p. 47, pl. 3, fig. 15, 1912, female, not male.

Hooker is correct in synonymizing *felti* with *abnormis*. Except for the abnormal discocubitus of the type of the latter, the two types are virtually identical, and I have labeled a specimen in the National Museum that I compared with both types as a homotype of both species. The males that Hooker referred to *abnormis* and the type of



*Ophion abnormis magniceps* Hooker have nothing to do with the present genus, but are *Ophion*.

In addition to the types I have examined the following specimens: Six females, Denver, Colo., April 26; two females, Denver, Colo., June 10, 1901, Dyar and Crandell; one female, Anniston Camp, Colo., June 1933, Cockerell; two females, Fort Collins, Colo., June 24, 1913; two females, Hamilton County, Kans., 3,350 feet, F. H. Snow; one female, Stanton County, Kans., 3,000 feet, S. J. Hunter.

## 22. Genus *STAUROPOCTONUS* Brauns

PLATE 50, FIGURE 15; PLATE 54, FIGURE 53; PLATE 55, FIGURE 83

*Stauropocionus* BRAUNS, Arch. Ver. Freunde Naturg. Mecklenburg, vol. 43, p. 93, (1889) 1890.—KRIECHBAUMER, Zeitschr. Hym. Dip., vol. 1, p. 22, 1901.—SZÉPLIGETI, in Wytzman, Genera insectorum, fasc. 34, p. 35, 1905 (as synonym of *Eremotylus* Foerster).—SCHMIEDEKNECHT, Opuscula ichneumonologica, fasc. 18, p. 1448, 1908; suppl., fasc. 24, p. 47, 1935. [Genotype: *Ophion bombycivorus* Gravenhorst.] Monobasic.

*Stauropodoctonus* [sic!] Brauns, MORLEY, A revision of the Ichneumonidae based on the collection in the British Museum (Natural History), pt. 1, p. 16, 1912 (part).—UCHIDA, Journ. Fac. Agr. Hokkaido Imp. Univ., vol. 21, p. 213, 1928 (part).

*Nipponophion* UCHIDA, Journ. Fac. Agr. Hokkaido Imp. Univ., vol. 21, p. 201, 1928. [Genotype: *Nipponophion variegatus* Uchida. By original designation.] New synonymy.

This and the next genus form a distinct group characterized especially by the entire lack of the occipital carina; very small mandible with the upper tooth shifted to the inner margin, so that when closed the mandible appears edentate; a longitudinal groove dividing the mesopleuron into nearly equal upper and lower parts; extremely narrow, attenuate stigma with radius near base, basally thickened and strongly curved radius; and the presence on the outer apical margin of the trochanter in middle and hind legs of a sharp decurved tooth. Of these, the peculiarly formed mandible and the trochanteral tooth occur only in these two genera and in no other genus do the other characters listed occur in the same combination.

Neither Szépligeti nor Morley nor Uchida understood this genus, for Szépligeti synonymized it with *Eremotylus* Foerster, Morley synonymized with it *Spilophion* Cameron, and Uchida accepted Morley's interpretation while redescribing it as *Nipponophion*. Both *Eremotylus* and *Spilophion* have the occipital carina distinct, whereas the lack of this carina is one of the most anomalous characters of *Stauropocionus*.

Head (pl. 50, fig. 15): Unusually small; temples somewhat convex but narrow and sharply receding; occipital carina entirely absent, postvertex descending perpendicularly from ocelli, which are very large and contiguous with eyes; eyes large, bulging, deeply emarginate,

parallel below antennae; face strongly convex, narrow, but broader than frons, clypeus almost continuous with face, convex, broadly rounded at apex, narrowly exposing labrum; malar space extremely short; mandible small, so strongly twisted that upper tooth is on inner margin; antenna long, very slender, attenuate.

**Thorax:** Pronotal sinus moderately broad, exposing spiracular sclerite; mesoscutum moderately convex, notaulices obsolete; scutellum margined only basally; mesopleuron longitudinally impressed from fovea to top of prepectus; postpectoral carina complete and high; propodeum briefly prolonged over hind coxae, basal carina very strong, apical carina not defined, basal constriction divided into median and lateral foveae. Wings (pl. 54, fig. 53) with dense long hair, a hairless area below base of stigma, but without fenestra; stigma very narrow, merging imperceptibly with metacarpus, radius near base; basal abscissa of radius conspicuously thickened and curved basally, apical abscissa strongly curved; discocubitus concavely curved basally, convexly curved apically, basal portion slightly convergent with basal vein; lower outer angle of second discoidal cell right; nervulus interstitial or postfurcal; postnervulus broken at or above middle; abscissula slightly thickened and weakly curved at base; nervellus rectangularly broken at about middle; legs extremely slender; apical joint of trochanter in middle and hing legs (pl. 55, fig. 83) with an acute tooth on outer side at apex; claws closely pectinate.

**Abdomen:** Slender, strongly compressed; petiole convex dorsally; tergite 2 broadly constricted basally, with a deep longitudinal groove on each side, but with no umbo, spiracles at apical two-fifths, epipleura separated and sharply infolded.

I have not seen the genotype, and the above description is drawn from a damaged specimen of *Nipponophion variegatus* Uchida and the new species described below. J. F. Perkins says (*in litt.*): "*S. bombycivorus* Gr. agrees entirely with the generic diagnosis of the Chinese species."

**STAUROPOCTONUS VARIEGATUS (Uchida), new combination**

*Nipponophion variegatus* UCHIDA, Journ. Fac. Agr. Hokkaido Imp. Univ., vol. 21, p. 201, 1928.

**STAUROPOCTONUS CHEZANUS, new species**

Distinct from all the other described species in its almost uniformly ferruginous color.

*Female*.—Length 25 mm., antenna incomplete.

Temples very narrow; combined face and clypeus twice as long as width of face; eye less than twice as long as broad; thorax sparsely and minutely punctate, mesopleuron below longitudinal furrow and metapleuron more coarsely and densely so, mesopleuron rugoso-punctate

before middle coxa; basal carina of propodeum only moderately high, basal area sloping into basal constriction, not precipitate, apical slope flat with rugae radiating from foramen, and outlined laterally by high curved rugae, below which the sides are vertically rugose.

Ferruginous; head largely yellow, stemmaticum black; scape, pedicel and anellus piceous above, flagellum yellowish ferruginous slightly darkened basally; mesoscutum with three brownish longitudinal fasciae, the median one darker and more distinctly defined; tergite 3 dorsally brownish, laterally together with entire fourth tergite yellowish; tergites beyond fourth dark ferruginous; wings faintly infumate, hairless area hyaline, base of costa and stigma and metacarpus reddish, venation elsewhere blackish; legs concolorous with body.

*Type locality*.—Beh Luh Din, 30 miles north of Chengtu, Szechwan, China.

*Type*.—U. S. N. M. No. 57608.

One specimen captured July 27, 1933, at 6,000 feet altitude by D. C. Graham.

### 23. AULOPHION,<sup>14</sup> new genus

PLATE 50, FIGURE 13; PLATE 52, FIGURE 49; PLATE 54, FIGURE 58

This is the American analog of *Stauropoctonus* Brauns, with which it shares all the most anomalous characters, but it is immediately distinguishable by its entire lack of the postpectoral carina and differs further as follows:

Temples (pl. 50, fig. 13) weakly convex and exceedingly narrow; eyes strongly convergent below emargination; clypeus more strongly rounded at apex, not or barely exposing labrum; pronotal sinus very broad; scutellum subquadrate, not margined basally; longitudinal impression of mesopleuron (pl. 52, fig. 49) in the form of a narrow groove; postpectoral carina entirely lacking; propodeum with basal and apical carinae complete to entirely lacking; forewing (pl. 54, fig. 58) with hairless area extending along base of radius, extreme base of radial cell also hairless; discocubitus sharply curved or subangulate at about middle, straight basally and weakly curved apically, basal portion strongly convergent with basal vein; lower outer angle of second discoidal cell sharply acute; nervulus antefurcal to interstitial; postnervulus broken far above, nervellus far below, middle; petiole flattened dorsally; tergite 2 with lateral grooves broad and shallow, epipleura not infolded, separated only basally and there only by thinner texture. Agreeing otherwise with the foregoing description of *Stauropoctonus*.

*Genotype*.—*Aulophion bicarinatus*, new species.

<sup>14</sup> From *aulos*=groove, referring to the groove on the mesopleuron.

**AULOPHION BICARINATUS, new species**

*Female*.—Length 20 mm., antenna 20 mm.

Head: Unsculptured except for very fine, sparse punctures on face; face at level of clypeal foveae distinctly narrower than frons; antenna as long as body, with 60 joints, all flagellar joints much longer than thick.

Thorax: Pronotum slightly tumid along dorsal and anterior lateral margins; mesoscutum minutely punctate; scutellum polished, its frenum and that of postscutellum finely punctate, not at all foveolate; mesopleuron polished above longitudinal groove, very minutely shagreened, finely punctate and mat below, as are also the mesosternum and metapleuron; propodeum with short, dense, erect pile, both basal and apical carinae complete and a single median carina from basal carina to apex, transverse carinae arcuate, higher laterally, median fovea of basal constriction longitudinally rugose, basal area minutely sculptured, surface behind carinae finely rugulose. Wings with basal abscissa of radius, measured across the curve, less than a third as long as apical abscissa: intercubitus slightly longer than second abscissa of cubitus; second discoidal cell nearly two-thirds as broad apically as long on subdiscoideus, postnervulus broken at upper third; intercubitella more than half as long as abscissula. Legs very long and slender, hind tibia very nearly reaching apex of abdomen.

Ferruginous; head (discolored but probably yellow), pronotum, pleura, anterolateral margins of mesoscutum, and front coxae yellow; antennae and abdomen from near base of tergite 3 infusate; wings hyaline, venation brown.

*Type locality*.—Costa Rica.

*Type*.—U. S. N. M. No. 57609.

One specimen received from the Paris Museum and captured in 1884 by de Lafon. It lacks most of the right antenna, parts of the left front and middle legs, and the apical three joints of both hind tarsi.

**AULOPHION EXCARINATUS, new species**

Differs from *bicarinatus* Cushman as follows:

*Male*.—Length 20 mm., antennae 22 mm.

Face at level of clypeal foveae hardly narrower than frons; antenna slightly longer than body; pronotum not tumid along margins; propodeum entirely without basal and median carinae and with only faint lateral traces of apical carina, minutely punctate-rugulose; basal abscissa of radius fully a third as long as apical abscissa; second discoidal cell hardly half as broad apically as long on subdiscoideus; intercubitella less than half as long as abscissula.

Entire head and thorax, except three broad ferruginous fasciae on mesoscutum, yellow, as are also all coxae and trochanters; legs elsewhere and abdomen stramineous, tergite 2 and dorsal edges of compressed portion of abdomen ferruginous; antenna with scape, pedicel and annellus piceous, flagellum ferruginous above, stramineous below; stigma, costa, metacarpus and thickened base of radius ferruginous.

*Type locality*.—San Esteban, near Puerto Cabello, Venezuela.

*Type*.—Collection of Henry K. and Marjorie C. Townes.

One specimen captured by P. J. Anduze on December 20, 1939.

#### 24. Genus *BANCHOGASTRA* Ashmead<sup>15</sup>

##### PLATE 56, FIGURE 93

*Banchogastra* ASHMEAD, Proc. U. S. Nat. Mus., vol. 23, p. 87, 1900; Fauna Hawaiensis, vol. 1, pt. 3, p. 343, pl. 9, fig. 3, 1901.—PERKINS, Fauna Hawaiensis, Suppl. 2, p. 680, 1910; Trans. Ent. Soc. London, p. 530, (1914) 1915. [Genotype: *Banchogastra nigra* Ashmead.] Monobasic.

Despite the stout form, especially of the abdomen, and the entire lack of the fenestra, this anomalous Hawaiian genus is more closely allied to *Enicospilus* than to *Ophion* in most of the important characters distinguishing those two genera. It is perhaps significant that neither *Ophion* nor any genus closely allied to it occurs in the endemic fauna of the Hawaiian Islands, whereas *Enicospilus* is represented by numerous species.

Head: Thick; temples strongly convex but considerably narrower than eyes; occiput rather deeply concave, carina complete; eyes and ocelli small, malar space and ocellocular line long; eyes broadly emarginate; face and frons broad, about equal in breadth; stemmaticum distinctly set off and somewhat elevated; clypeus narrow, apex broadly rounded, labrum narrowly exposed; mandible much twisted, abruptly narrowed from base; antenna slender, filiform.

Thorax: Short and stout; pronotal sinus narrow, spiracular sclerite concealed; mesoscutum in profile moderately convex, notaulices obsolete; scutellum margined to top of the abrupt apical slope; speculum not at all defined; prepectoral carina incomplete above; postpectoral carina complete; propodeum very short, precipitous behind, not at all overlapping hind coxae, only basal carina present, basal constriction not interrupted. Wings with dense setae and without fenestra or hairless area; stigma narrowly triangular, radius at about basal third; basal abscissa of radius straight and slender, apical abscissa curving strongly from base; second discoidal cell narrow, nearly or quite pointed at base, lower apical angle acute, discocubitus

<sup>15</sup> In his "Catalogue and Reclassification of the Nearctic Ichneumonidae" (Mem. Amer. Ent. Soc., No. 11, p. 737, 1944-45) Townes has synonymized this genus with *Enicospilus*. I exclude from *Enicospilus* all species lacking the fenestra. This and the unusually stout habitus are, I think, sufficient to justify the retention of *Banchogastra*.

gently curved, not broken, its basal portion parallel to basal vein; nervulus antefurcal; frenulum short, with 6 or 7 hooks; abscissula straight; nervellus broken slightly below middle, upper abscissa inclivous. Legs short and stout; claws closely pectinate.

Abdomen (pl. 56, fig. 93): Short, stout, weakly compressed; first segment very broad, depressed, sternite not nearly reaching spiracles; tergite 2 extremely short and broad, hardly as long as third, without umbo, spiracles basad of middle, epipleura defined only basally.

The only two species known are from the Hawaiian Islands. They are black insects having more the general aspect of an exceptionally stout campoplegine than of an ophionine.

## 25. Genus *PYCNOPHION* Ashmead

### PLATE 56, FIGURE 90

*Pycnophion* ASHMEAD, Proc. U. S. Nat. Mus., vol. 23, p. 87, 1900; Fauna Hawaiensis, vol. 1, pt. 3, p. 344, pl. 9, fig. 4, 1901.—PERKINS, Fauna Hawaiensis, Suppl. 2, p. 680, 1910; Trans. Ent. Soc. London, 1914, p. 530, 1915. [Genotype: *Pycnophion molokaiensis* Ashmead.] Monobasic.

This is another anomalous Hawaiian genus allied to *Enicospilus* but remarkably different in general form, in its lack of the fenestra and in the strongly exserted, recurved ovipositor and obsolete postpectoral carina. The wing venation is nearly the same as in *Bancho-gastra*, but the form of the body is very different.

Head: Rather thick, temples narrow, weakly convex and very sharply receding; occiput narrow and weakly concave, carina complete; eyes large and bulging, deeply emarginate; vertex narrow; stemmaticum not elevated, ocelli small, not touching eyes; malar space distinct; mandible twisted, strongly narrowing from base to middle; clypeus rounded at apex, in profile strongly convex apically, labrum narrowly exposed; antenna very slender, filiform, not or barely as long as body.

Thorax: Stout; pronotal sinus narrow, spiracular sclerite concealed; mesoscutum precipitous anteriorly, notaulices obsolete; scutellum broad, margined nearly or quite to apex; prepectoral carina distinct, not quite reaching anterior margin of mesopleuron; postpectoral carina obsoletely indicated only at sides; speculum not defined; metapleuron very strongly tumid; propodeum short, precipitous behind, with or without the basal carina, basal constriction not interrupted. Wings sparsely hairy except apically, with a hairless area below base of stigma, but without fenestra; stigma narrowly triangular, radius at about basal third; basal abscissa of radius straight, slender, apical abscissa strongly curved; second discoidal cell narrow, pointed or very narrow at base, lower apical angle right or slightly acute, discocubitus gently curved, basal portion parallel to basal vein;

nervulus antefurcal; frenulum short, with 5 to 8 hooks; abscissula straight; nervellus broken below middle, upper abscissa inclivous. Legs with femora rather stout, tibiae and tarsi long and slender, claws closely pectinate.

Abdomen (pl. 56, fig. 90): Stout, moderately compressed; first segment with petiole nearly terete, postpetiole depressed; ovipositor exerted at least the length of first segment, usually recurved, sheath slender.

I have seen all three of the described Hawaiian species, the single specimen of *fumipennis* Perkins unfortunately headless. This species exhibits some gradation toward *Enicospilus* in its long, narrow second tergite with the spiracles well beyond the middle and its straight ovipositor. In the other two species the second tergite is notably short with the spiracles at about the middle, and the ovipositor is recurved.

## 26. Genus *SPILOPHION* Cameron

PLATE 54, FIGURE 56; PLATE 55, FIGURE 77

*Spilophion* CAMERON, *Spolia Zeylanica*, vol. 3, pt. 10, p. 124, pl. B, fig. 13, 1905.—

MORLEY, A revision of the Ichneumonidae based on the collection in the British Museum (Natural History), pt. 1, p. 16, 1912 (as synonym of *Stauro-podoctonus* [sic!] Brauns). [Genotype: *Spilophion maculipennis* Cameron.] Monobasic.

*Coiloneura* SZÉPLIGETI, in Wytsman, *Genera Insectorum*, fasc. 34, p. 35, 1905.

[Genotype: *Coiloneura melanostigma* Szépligeti. By designation of Viereck, U. S. Nat. Mus. Bull. 83, p. 35, 1914.]

Since *Spilophion* and *Coiloneura* were published in the same year and apparently at almost the same time there is some question as to which actually has precedence. The evidence that I have been able to gather is as follows: Part 10 of volume 3 of "*Spolia Zeylanica*" bears the date October 1905. Fascicle 34 of "*Genera Insectorum*" is dated simply 1905, but at the bottom of the last page is printed the notation "Budapest, 14. August, 1905," which presumably is the date on which the manuscript was transmitted by Szépligeti. This fascicle of the "*Genera Insectorum*" was received at the library of the Smithsonian Institution on November 15, 1905, and the "*Spolia Zeylanica*" on November 23, 1905. If we assume that both were mailed immediately on publication, a much longer time would have been required for the "*Spolia Zeylanica*", published in Ceylon, to reach its destination than for the "*Genera Insectorum*," published in Brussels, and the fact that the former was received only 8 days after the latter would seem to give it precedence in publication. Moreover, among the recommendations under Article 28 of the International Code of Zoological Nomenclature are two which would seem to give preference to *Spilophion* over *Coiloneura*. One recommendation is

to give preference to that genus for which a genotype is specified. No genotype was specified for either, but *Spilophion* is monobasic and *Coiloneura* was based on two species. The second recommendation as stated applies to species but perhaps may also be interpreted to apply to genera. It is that a "specific name accompanied by both description and figure stands in preference to one accompanied only by a diagnosis or only by a figure." *Spilophion maculipennis* is both described and figured. For the above reasons I prefer to use *Spilophion* as the name of this genus.

The presence in this genus of the occipital carina is sufficient to prove Morley's error in synonymizing it with *Stauropogon*.

In a majority of the group characters *Spilophion* agrees with *Enicospilus*, especially in the body characters, but differs in most of the wing characters and in the anomalous hind claws and penultimate hook of the frenulum.

Head: Rather thin with temples strongly receding; occipital carina strong but not quite reaching hypostomal carina; eyes and ocelli large, eyes deeply emarginate, slightly more widely separated across clypeal foveae than across frons; clypeus convex, broadly truncate, with a narrow reflexed margin, labrum exposed; mandible broad, only slightly twisted and little narrower at apex than at base; antenna longer than body, very slender, filiform.

Thorax: Pronotal sinus very narrow, spiracular sclerite concealed; notaulices absent; scutellum flat, strongly margined; speculum not defined; prepectoral carina strong, postpectoral carina complete; propodeum flattened, basal carina strong, basal constriction uninterrupted. Wings (pl. 54, fig. 56) densely hairy, with a large hairless area below stigma and base of radius, but without a well-defined fenestra and with no scleromes; stigma small, triangular, tapering beyond radius, which is distant from base; basal abscissa of radius thickened at base, slightly bent or curved immediately beyond thickening, thence slender, apical abscissa strongly curved; second discoidal cell very narrow at base, its lower posterior angle slightly acute; abscissula (pl. 54, fig. 56b) curved; frenulum (pl. 54, fig. 56c) with 5 or 6 hooks, the penultimate hook usually larger and of different form from others; nervellus broken somewhat below middle at a right angle. Legs extremely slender, apex of tibia hardly reaching to apex of abdomen; claw of hind tarsus (pl. 55, fig. 77) sharply bent so that apical portion forms an acute angle with base, last tooth of pecten beyond apex of claw.

Abdomen: Slender; postpetiole little broader than petiole; tergite 2 without umbo, spiracles shortly basad of apical third; epipleura completely separated and infolded; ovipositor sheath not exerted.



## SPILOPHION MACULIPENNIS Cameron

*Spilophion maculipennis* CAMERON, Spolia Zeylanica, vol. 3, p. 124, pl. B, fig. 13, 1905.

*Stauropodoctonus orientalis* MORLEY, A revision of the Ichneumonidae based on the collection in the British Museum (Natural History), pt. 1, p. 18, 1912. New name for *Spilophion maculipennis* Cameron, not (*Enicospilus*) *Stauropodoctonus maculipennis* (Cameron), 1886.

Because of Morley's error in transferring both this species and *Enicospilus maculipennis* Cameron to *Stauropodoctonus*, thereby making them secondary homonyms, it was necessary for him to rename the later species, but since they are not congeneric and neither is a *Stauropodoctonus* I here restore Cameron's name for the present species.

*S. maculipennis* is widely distributed in the Indo-Malayan Region.

27. Genus ABANCHOGASTRA Perkins<sup>16</sup>

## PLATE 54, FIGURE 60

*Athyreodon* ASHMEAD, Fauna Hawaiiensis, vol. 1, pt. 3, p. 343, pl. 9, fig. 2, 1901 (not Ashmead, 1900).—PERKINS, Fauna Hawaiiensis, vol. 2, pt. 6, p. 679, 1910. [Genotype: *Athyreodon hawaiiensis* Ashmead.] Monobasic.

*Abanchogastra* PERKINS, Trans. Ent. Soc. London, 1902, pt. 2, p. 141.—SCHMIEDEKNECHT, Opuscula ichneumonologica, fasc. 18, p. 1421, 1908.—CUSHMAN, Proc. Hawaiian Ent. Soc., vol. 12, p. 53, 1944. [Genotype: (*Abanchogastra debilis* Perkins) = *A. hawaiiensis* (Ashmead).] Monobasic.

This genus presents a curious combination of the characters of *Ophion* and *Enicospilus*, the venation largely that of *Ophion* and the head and body characters those of *Enicospilus*. In the last reference cited above I have discussed the synonymy of the genus and that of the genotype.

Head: With narrow, strongly receding temples; occipital carina fine but complete; eyes deeply emarginate; ocelli large, nearly (♀) or quite (♂) touching eyes; frons slightly narrower than face; clypeus hardly separated, apex broadly rounded, labrum rather broadly exposed; mandible abruptly narrowed from near base, strongly twisted, upper tooth longer than lower tooth; trophi normal; antennae very slender, nearly or quite as long as body.

Thorax: Slender; pronotum without definite scrobes, pronotal sinus narrow, spiracular sclerite concealed; notaulices not at all indicated; scutellum narrow, margined to beyond middle; mesopleuron nearly flat with fovea obsolete and without defined speculum; prepectus not reaching anterior margin of mesopleuron but ending abruptly just above level of lower angle of pronotum; sternaules not at all indicated; mesosternum evenly convex; postpectus weak or narrowly

<sup>16</sup> Townes (Mem. Amer. Ent. Soc., No. 11, 1944-45) has synonymized this genus with *Enicospilus*. Because of the lack of the fenestra and the generally *Ophion*-like venation, I retain it as a distinct genus.

interrupted medially; metapleuron weakly convex, lower marginal carina rather weak throughout; propodeum, in profile, gently convex, overlapping about basal third of hind coxa, entirely without carinae, basal constriction uninterrupted, frenum long, spiracles rather small and close to bottom of constriction. Wings (pl. 54, fig. 60) densely hairy both dorsally and ventrally, without fenestra or hairless area in discocubital cell; stigma broad with radius shortly before middle; radius with basal abscissa nearly straight, not thickened, apical abscissa curving strongly forward at base; veins of transverse brace (in genotype) in ratio of 1:3:3; second discoidal cell very narrow at base, half as broad apically as long posteriorly, posterior angle acute, discocubitus strongly curved; nervulus strongly antefurcal; abscissula rather strongly curved basally; nervellus broken at about middle, reclivous, upper abscissa perpendicular. Legs very slender; hind coxa elongate; inner hind calcarium less than half as long as basitarsus, tapering from base and with a conspicuous fringe of long hair along inner margin; basitarsus nearly or quite as long as rest of joints together, joints 4 and 5 subequal and together hardly longer than 3; claws small, very coarsely pectinate, the pecten consisting of 4 or 5 long strong teeth.

Abdomen: Slender, strongly compressed apically; tergite 1 gradually broadening, postpetiole hardly twice as broad as petiole, spiracles just posterior to apical third; tergite 2 slightly shorter than 1, with shallow basal lateral grooves, but without umbo, gastrocoeli elongate, midway between base and spiracles, which are at apical third; ovipositor sheath hardly reaching apex.

## 28. Genus ENICOSPILUS Stephens

PLATE 49, FIGURE 2; PLATE 50, FIGURES 9, 10, 16, 22; PLATE 52, FIGURES 40, 44  
PLATE 53, FIGURE 52; PLATE 54, FIGURES 61, 62; PLATE 55, FIGURES 63-70, 74,  
80; PLATE 56, FIGURES 100, 101

*Enicospilus* STEPHENS, Catalogue of British insects, p. 352, 1820 (without description or species); Illustrations of British entomology, vol. 7, p. 126, pl. 40, fig. 4, 1835, p. 311, 1845.—CUSHMAN, Proc. Hawaiian Ent. Soc., vol. 12, p. 39, 1944. [Genotype: (*Ophion merdarius* Stephens, not Gravenhorst) = *Ophion combustus* Gravenhorst.] Monobasic.

*Henicospilus* AGASSIZ, Nomenclatoris zoologici index universalis, p. 178, 1846. Emendation of *Enicospilus* Stephens. [Autotype: *Ophion undulatus* Gravenhorst.]

*Allocamptus* FOERSTER, Verh. naturh. Ver. preuss. Rheinlande, vol. 25, p. 150, 1868.—THOMSON, Opuscula entomologica, fasc. 12, p. 1186, 1888. [Genotype: *Ophion combustus* Gravenhorst.] Present inclusion and designation.

*Allocamptus* THOMSON, Opuscula entomologica, fasc. 12, p. 1189, 1888, not Foerster. [Genotype: *Ophion undulatus* Gravenhorst.] Monobasic.

- Dispilus* KRIECHBAUMER, Berlin. Ent. Zeitschr., vol. 39, p. 309, 1894; Zeitschr. Hym. Dip., vol. 22, p. 154, 1901. [Genotype: *Ophion* (*Dispilus*) *natalensis* Kriechbaumer.] Monobasic.
- Eremotylus* (Foerster) ASHMEAD, Trans. Amer. Ent. Soc., vol. 23, p. 192, 1896, not (Foerster) Thomson. [Genotype: (*Eremotylus arctiae* Ashmead) = *Enicospilus glabratus* (Say).] New combination. Monobasic.
- Pleuroneurophion* ASHMEAD, Proc. U. S. Nat. Mus., vol. 23, p. 86, 1900.—CUSHMAN, Proc. Hawaiian Ent. Soc., vol. 12, p. 43, 1944. [Genotype: *Pleuroneurophion hawaiiensis* Ashmead.] Monobasic.
- Cymatoneura* KRIECHBAUMER, Zeitschr. Hym. Dip., vol. 1, pp. 22, 74, 1901. [Genotype: *Ophion undulatus* Gravenhorst. By designation of Viereck, Proc. U. S. Nat. Mus., vol. 42, p. 635, 1912.]
- Pterospilus* KRIECHBAUMER, Zeitschr. Hym. Dip., vol. 1, p. 156, 1901. [Genotype: *Ophion* (*Enicospilus*) *dubius* Tosquinet. By designation of Viereck, U. S. Nat. Mus. Bull. 83, p. 126, 1914.]
- Triaspilus* KRIECHBAUMER, Zeitschr. Hym. Dip., vol. 1, p. 156, 1901. [Genotype: *Ophion* (*Enicospilus*) *trimaculatus* Tosquinet.] Monobasic.
- Eremotylus* (Foerster) KRIECHBAUMER, Zeitschr. Hym. Dip., vol. 1, p. 152, 1901, not (Foerster) Thomson. [Genotype: *Ophion undulatus* Gravenhorst. By present designation.]
- Leptophion* CAMERON, Proc. Zool. Soc. London, 1901, p. 227. [Genotype: *Leptophion longiventris* Cameron.] Monobasic.
- Dicamptus* SZÉPLIGETI, in Wytsman, Genera insectorum, fasc. 34, p. 28, 1905. [Genotype: *Dicamptus giganteus* Szépligeti.] Monobasic.
- Metophion* SZÉPLIGETI, in Wytsman, Genera insectorum, fasc. 34, p. 28, 1905. [Genotype: *Metophion bicolor* Szépligeti. By designation of Viereck, U. S. Nat. Mus. Bull. 83, p. 94, 1914.]
- Ceratospilus* SZÉPLIGETI, in Wytsman, Genera insectorum, fasc. 34, p. 28, 1905. [Genotype: *Ceratospilus biroi* Szépligeti.] Monobasic.
- Atoponeura* SZÉPLIGETI, in Wytsman, Genera insectorum, fasc. 34, p. 34, 1905. [Genotype: (*Atoponeura concolor* Szépligeti, preoccupied in *Enicospilus* by *E. concolor* [Cresson]) = *Enicospilus atoponeurus*, new name.] Monobasic.
- Ophiomorpha* SZÉPLIGETI, in Wytsman, Genera insectorum, fasc. 34, p. 34, 1905. [Genotype: (*Ophion curvinervis* Cameron, preoccupied by *O. curvinervis* Kriechbaumer) = *Ophion cameronii* Dalla Torre. By designation of Hooker, Trans. Amer. Ent. Soc., vol. 38, p. 134, 1912.]
- Cryptocamptus* BRÉTHES, Anal. Mus. Nac. Buenos Aires, vol. 19, p. 230, 1909 (new name for *Allocamptus* Thomson, not Foerster). [Autotype: *Ophion undulatus* Gravenhorst.]
- Eremotylodes* PERKINS, Trans. Ent. Soc. London, 1914, pp. 530, 532.—CUSHMAN, Proc. Hawaiian Ent. Soc., vol. 12, p. 45, 1944. [Genotype: *Eremotylus orbitalis* Ashmead.] Monobasic.
- Amesospilus* ENDERLEIN, in Michaelson, Beitr. Kentn. Land- und Süßwasserfauna Deut. Sudw. Afrikas, vol. 1, p. 222, 1914–1916. [Genotype: *Ophion unicallosus* Vollenhoven.] Monobasic and designated.
- Schizospilus* SEYRIG, Mus. Nat. Hist. Nat., Mission Scientifique de l'Omo, vol. 3, Zool. fasc. 18, Hym. 2, Ichn., p. 79, 1935. [Genotype: *Schizospilus divisus* Seyrig. Original designation.]

As in the case of *Ophion* complete citations in the above synonymy, especially under *Enicospilus* and *Henicospilus*, would require space out of proportion to its value. The most comprehensive works are

the same as those cited under *Ophion*, but as with that genus, the major portion of the literature is scattered through many periodicals and the majority of the species are not to be found in published keys.

The name of this genus was originally spelled *Enicospilus*, but Agassiz (1846) emended it to *Henicospilus*, presumably supposing that Stephens had derived the first part of the name from the Greek word *ἑνικός*, he being the proper transliteration of *ē*. Several authors, notably Dalla Torre, have adopted the emended spelling, while others, notably Schmiedeknecht, have used the original spelling. To obtain an unbiased opinion as to the proper form of the name I recently submitted the question to a committee on nomenclature set up in the division of insect identification, U. S. Bureau of Entomology and Plant Quarantine. The unanimous opinion of the committee was that, since Stephens did not indicate the derivation of the name, the original spelling should be preserved. This decision was based on Opinion 34 of the International Commission on Zoological Nomenclature, which rules that unless evidence of the derivation of a name is clearly indicated in the original publication the original spelling should be preserved.

It will be noted that I have cited as the genotype of *Enicospilus*, *Ophion combustus* Gravenhorst instead of *Ophion merdarius* Gravenhorst as given by Viereck, 1914. This change is based on Stephens's identification of his own figure, originally identified as "*Enicospilus merdarius*" without indication of the author of the species, as *combustus* Gravenhorst; in other words, (*Enicospilus merdarius* Stephens, 1835, not [*Ophion*] *Enicospilus merdarius* [Gravenhorst]) = *Enicospilus combustus* (Gravenhorst). In this interpretation the committee mentioned above also concurred unanimously.

Head (pl. 50, figs. 9, 22): Occipital carina present; temple usually narrow and receding, rarely buccate and reaching outside tangent of eye; eyes and ocelli large, eyes deeply emarginate; mandible usually abruptly narrowed between base and middle and strongly twisted, rarely gradually narrowed and only slightly twisted; maxillae and labium of normal length.

Thorax: Pronotal sinus (pl. 55, fig. 74) narrow, spiracular sclerite concealed; scutellum margined, usually to apex; speculum not defined; prepectoral and postpectoral carinae (pl. 52, fig. 40) strong, the latter rarely interrupted medially; basal constriction of propodeum (pl. 52, fig. 44) not divided. Wings (pl. 53, fig. 52; pl. 54, figs. 61, 62; pl. 55, fig. 70) with stigma, narrow, emitting radius near base, usually subparallel-sided distad of radius and rather abruptly tapering apically, rarely very slender and merging imperceptibly with metacarpus; basal abscissa of radius thickened and sinuate or undulant, very rarely straight and unthickened; apical abscissa strongly curved; fenestra

present, with or without scleromes, rarely small and poorly defined; abscissula straight; nervellus broken below (rarely at) middle, upper abscissa usually inclivous. Legs with middle and hind trochanters not toothed apically; pectination of claws normal (pl. 55, fig. 80).

Abdomen (pl. 56, figs. 100, 101): Tergite 2 without an umbo, its spiracles usually at or near apical third, epipleura usually completely separated and infolded, very rarely partially or entirely unseparated.

In some of the characters herein treated as making up a combination that identifies an *Enicospilus*, especially in those of the wings, there is considerable variation. Most of the synonyms listed above are based on variations of wing characters.

The stigma, typically almost parallel-sided with a rather abrupt apical taper, occasionally is like that of *Thyreodon*, extremely long and slender and merging imperceptibly with the metacarpus. The basal abscissa of the radius exhibits variation from marked curvature and undulation even exceeding that of the genotype of *Dicamptus* to the straightness and slenderness of that typical of *Ophion*. The fenestra varies from a very small and poorly defined one, as in *Ophiomorpha concolor* Szépligeti, to one occupying most of the apical part of the discocubital cell and with all of the structures distinct; some species lack scleromes entirely, others have from one to six. If only one sclerome is present it may be either the proximal or the distal one, or the quadra may be faintly sclerotized over most of its surface. Other marked differences are exhibited in the course or form of the discocubitus, the shape of the second discoidal cell, the proportional lengths of the veins of the transverse brace, the strength of the post-pectoral carina (rarely interrupted medially), and the form and sculpture of the propodeum. In a very large majority of the species the spiracles of tergite 2 are at or near the apical third, but in a few unusually stout species they are much closer to, though still distinctly beyond, the middle. Such species also tend to a lack of definite separation between the second tergite and its epipleura, whereas typically the epipleura are completely separated and inflexed; other species exhibit partial separation, the basal half or more of the epipleuron being separated and inflexed and the apical portion not clearly separated and not inflexed. Typically the mandible is abruptly narrowed before the middle and so twisted that the two teeth are in a plane nearly vertical to the longitudinal body axis, but the variation in its form extends all the way from nearly the condition found in *Stauropoctonus*, with the torsion so great that the upper tooth appears to be on the inner margin, to nearly that in *Ophion*, with less torsion and gradual taper from base to apex as exhibited by *Enicospilus flavoplagiatus* Cushman.

Few species show marked departure from the normal in more than one of the characters.

The use of the different number of scleromes as a basis for the segregation of genera or subgenera, as in the case of *Dispilus* Kriechbaumer, *Trispilus* Kriechbaumer, and *Schizospilus* Seyrig cannot be defended, for it separates closely related species and groups together unrelated species. The same is true of so-called genera based on the position of the scleromes, such as *Amesospilus* Enderlein, or on the form of the basal abscissa of radius, such as *Dicamptus* Szépligeti, or of the discocubitus, such as *Atoponeura* Szépligeti. For example, from the figures alone in a paper by Seyrig (Mission Scientifique de l'Omo, vol. 3, fasc. 18, Ichneumonidae, pt. 2, 1935, Mus. Nat. Hist. Nat.), in which he argues for the division of *Enicospilus* into three genera entirely on the number and position of the alar scleromes, it seems quite obvious that *Enicospilus medius* Seyrig, *E. mollis* Seyrig, *Amesospilus justus* Seyrig, and *A. rupeus* Seyrig are more closely related to one another than any is to *Amesospilus fortis* Seyrig or to *Enicospilus rubens* Tosquinet; and the other characters mentioned in the descriptions seem to bear this out.

To argue that a very large genus is *ipso facto* unwieldy and should therefore be broken up into smaller genera by the most convenient characters is unscientific. Many of the same characters can be used in a more truthful manner within a genus, in association with other characters, to segregate really related species. It is entirely possible that by the use of combinations of characters the huge genus *Enicospilus* can be divided into natural groups of somewhat less than generic status, and it may be found possible to use some of the many names already proposed in the subgeneric sense.

For additional examples of fenestra and wing venation in *Enicospilus* beyond those in the present paper and in the paper by Seyrig cited above, see the figures in the following publications: Cushman, Arb. morph.-tax. Ent. Beihefte aus Berlin-Dahlem, vol. 4, p. 296, figs. 1-14, 1937; Cushman, Proc. Hawaiian Ent. Soc., vol. 12, p. 55, 1944; Cameron, Biologia Centrali-Americana, Ins., Hym., vol. 1, pl. 12, 1886; Brues, Bull. Mus. Comp. Zool., vol. 62, pl. 1, 1918.

In erecting his genera *Allocamptus* and *Eremotylus*, Foerster was segregating from the old genus *Ophion* those European species in which the discocubitus is not angularly broken, *Allocamptus* to include those with scleromes in the discocubital cell and *Eremotylus* those without scleromes. In his unpublished manuscript he placed *Ophion repentinus* Holmgren, *ramidulus* Gravenhorst, *combustus* Gravenhorst, and *merdarius* Gravenhorst in *Allocamptus*, with the last indicated as his choice for genotype. To *Eremotylus* he assigned *O. bombycivorus* Gravenhorst and *undulatus* Gravenhorst, without indicating the

genotype. To *Eremotylus* in the sense of Thomson have been referred such American species as (*Thyreodon*) *Enicospilus texanus* (Ashmead) (new combination) (pl. 55, fig. 64), (*Eremotylus*) *Enicospilus rufoniger* (Hooker) (new combination) (pl. 55, fig. 66), and *Enicospilus americanus* (Christ) (pl. 55, fig. 69), the last under the name *Eremotylus macrurus* (Linnaeus). Thomson's statement that *Allocamptus* Foerster is coextensive with *Enicospilus* appears to have been the first (implied) reference of species to *Allocamptus*, and the name in this restricted sense appears never to have been used in combination with a specific name, most authors having followed Thomson's lead in applying to it *Ophion undulatus* Gravenhorst. That Thomson considered Foerster's generic names invalid because of lack of associated species is shown by his use of the names *Allocamptus* and *Eremotylus*. He applied *Allocamptus* to what Foerster thought of as *Eremotylus* and *Eremotylus* to something different from either, that is, *Ophion marginatus* (Gravenhorst) Jurine. *O. undulatus* should not be accepted as the genotype of *Allocamptus* Foerster, as was indicated by Viereck (1914), since it obviously does not agree with the original description, because of the lack of scleromes; and *Allocamptus* Thomson is a different concept, even though both are here considered synonymous with *Enicospilus*. The case of *Eremotylus* is somewhat different, for *Ophion marginatus*, the designated genotype, apparently agrees with the original description, and that genus should be accredited to Foerster, even though it appears that Thomson considered that he was publishing it in a valid manner for the first time.

*Dispilus* Kriechbaumer first appeared as a subgeneric name under *Enicospilus* without description other than that of its genotype. In his second reference to the name Kriechbaumer proposed *Pterospilus* as a new genus to include the subgenera *Henicospilus* (to be restricted to species with one alar sclerome), *Dispilus* (with two scleromes), and *Trispilus*, a new subgenus (with three scleromes).

Both the angulate discocubitus and the small fenestra exhibited by the genotype of *Pleuroneurophion* Ashmead (pl. 55, fig. 68) occur elsewhere in *Enicospilus*, usually not in combination. The only really anomalous feature of *Pleuroneurophion* is the exerted ovipositor (pl. 56, fig. 100). None of the species referred to *Pleuroneurophion* by Cameron, Szépligeti, and Uchida agrees in this character. In the paper cited above I have already pointed out these facts and treated *Pleuroneurophion* as a subgenus of *Enicospilus*.

The original inclusion of *Ophion undulatus* Gravenhorst in *Cymatoneura* and its subsequent designation as genotype by Viereck makes that genus isogenotypic with *Allocamptus* Thomson. Those who recognize this as a genus distinct from *Enicospilus* should use *Cymatoneura* as the generic name, since *Allocamptus* Foerster has priority

over *Allocamptus* Thomson. In describing *Cymatoneura*, Kriechbaumer mentioned only two characters, the lack of scleromes in the wing and the course of the basal abscissa of the radius, "an oder nahe der Basis verdickt, geschlangelt oder wellenförmig." As I have indicated elsewhere, both of these structures are subject to great variation within *Enicospilus*. The really most characteristic feature of the genotype of *Cymatoneura* is the form of the head with the temple strongly buccate behind the upper part of the eye and rapidly diminishing in breadth and convexity below. This does not occur in any of the other species referred to *Cymatoneura* by Kriechbaumer or in others that I know, though many have the temples strongly convex but more uniformly so. Some of these, including the genotype of *Enicospilus*, have distinct scleromes and the radius very different. Others, with the wing characters of *Cymatoneura*, have the temples very narrow. Another somewhat peculiar feature of the genotype is the slight concavity of the clypeus, best seen in profile. This is approached in such species as (*Thyreodon*) *Enicospilus texanus* (Ashmead),<sup>17</sup> in which the clypeus is straight in profile with no inflection or reflexed margin apically. Thomson was quite wrong in stating that *undulatus* lacks the postpectoral carina.

The synonymy of *Leptophion* Cameron is on the authority of J. F. Perkins, who states that the genotype has alar scleromes and that the claws are very sharply bent apically.

There is nothing in the description of *Dicamptus* Szépligeti to distinguish it from *Enicospilus*. Though I have been unable to find a specimen of the genotype in the material available, I have identified (*Dicamptus*) *Enicospilus grammospilus* (Enderlein) (new combination) (pl. 55, fig. 70), which appears to be properly referred to *Dicamptus*, and on the strength of this synonymize *Dicamptus*. Morley treats *Dicamptus* as a subgenus of *Allocamptus* Thomson, thereby imputing to it "vertical" mandibles. Uchida, on the other hand, states that the mandibles are "horizontal." He synonymizes "*Allocamptus* Morley (not Thomson)" with *Dicamptus*, overlooking the fact that Morley included in *Allocamptus* the genotype, *undulatus* (Gravenhorst).

Most of the few characters given in the original description of *Metophion* Szépligeti (the presence of two scleromes in the wing, the strongly curved apical abscissa of the radius, and the margined scutellum) indicate affinity with *Enicospilus*; in fact, the only discordant character is found in the expression "randmal nicht ausgebildet." One would hardly say that the stigma is not developed in *Enicospilus* or in any genus of Ophionini that I have seen. Before me are specimens of a specifically unidentified species of *Enicospilus* from the

<sup>17</sup> New combination.



Oriental fauna that agree with the description of *Metophion* in all but this character and in having the nervulus antefurcal rather than postfurcal. They also agree with the description of the genotype in the form of the alar scleromes, "einem mondförmigen und einem gewöhnlichen Chitinleck," that is, a somewhat triangular proximal sclerome and a crescentic one on the anterodistal margin of the quadra. Another character worthy of special mention in which the specimens agree with the generic description is the unusually narrow, sometimes almost pointed, base of the second discoidal cell. On the strength of these facts I synonymize *Metophion* with *Enicospilus*.

I have not seen the genotype of *Ceratospilus* Szépligeti, but certain Philippine specimens of *Enicospilus* agree in all but the postfurcal nervulus, and this is too subject to variation for recognition as a generic character.

Neither the medially thickened discocubitus nor the lack of scleromes is sufficient to segregate *Atoponeura* Szépligeti as a genus distinct from *Enicospilus*. An unidentified species of *Enicospilus* from the Oriental Region exhibits these two characters (pl. 55, fig. 67).

It seems doubtful that Szépligeti knew the designated genotype of *Ophiomorpha*, although he included it originally. In describing *Ophion curvinervis*, Cameron stated, and his figure shows, that the basal abscissa of the radius is distinctly curved, which would preclude its tracing to *Ophiomorpha* in Szépligeti's key and its agreement with the original description of the genus. I have examined two specimens of *Ophiomorpha concolor* Szépligeti,<sup>18</sup> the most logical choice for genotype, identified by Seyrig, and find that it has the basal abscissa straight, only slightly thickened and very gradually tapering from base to apex; also, the fenestra is obsolescent, being represented only by a small hairless area in the normal position of the fenestra. Unfortunately, in describing *curvinervis* Cameron refers to the fenestra only with the observation that the wings lack scleromes.

*Cryptocamptus* Brèthes was proposed as a substitute for *Allocamptus* Thomson, not Foerster, its author not realizing that *Cymatoneura* was already available.

In describing *Eremotylodes* in a key to genera, Perkins did not indicate any type except inferentially. On page 529 of the paper in which the genus was described (p. 530) he stated, "I have not seen the typical species of *Eremotylus*, Först., and I think that Ashmead is wrong in attributing the one variable Hawaiian species to it." On page 532 in a discussion of the variation of Hawaiian Ophionini he employs the combination "*Eremotylodes orbitalis*" without giving the author of the species, but it seems entirely clear that *Eremotylus*

<sup>18</sup> (*Ophiomorpha concolor* Szépligeti, preoccupied in *Enicospilus* by *E. concolor* Cameron) = *Enicospilus parvifenestratus*, new name.

*orbitalis* Ashmead is intended as the genotype of *Eremotylodes*, and Viereck so interpreted it. In the reference cited above I have treated *Eremotylodes* as a subgenus of *Enicospilus* showing that the fenestra may be large or small and with or without scleromes. A part of the wing of *Enicospilus* (*Eremotylodes*) *fullawayi* Cushman is illustrated herewith (pl. 55, fig. 65).

*Amesospilus* Enderlein is another segregate from *Enicospilus* based on a wing character, the lack of central scleromes, which it shares with many otherwise very diverse species.

*Schizospilus* Seyrig is a frankly artificial genus distinguished from *Enicospilus* solely by the possession of two or more scleromes on the quadra.

#### GENERA OF OPHIONINI NOT INCLUDED IN THIS REVISION

##### Genus BARYTATOCEPHALUS Schulz

*Barycephalus* BRAUNS, Termész. Füzet., vol. 18, p. 43, 1895.—SZÉPLIGETI, in Wytsman, Genera insectorum, fasc. 34, p. 24, 1905.—SCHMIEDEKNECHT, Opuscula ichneumonologica, fasc. 18, p. 1426, 1908; suppl., fasc. 24, p. 15, 1935.—SHESTAKOV, Konowia, vol. 5, p. 257, 1926 (preoccupied by *Barycephalus* Günther, 1860). [Genotype: *Barycephalus mocsaryi* Brauns. By designation of Viereck, U. S. Nat. Mus. Bull. 83, p. 19, 1914.]

*Barytatocephalus* SCHULZ, Zool. Ann., vol. 4, p. 23, (1909) 1911 (substitute name for *Barycephalus* Brauns, preoccupied). [Genotype: *Barytatocephalus mocsaryi* Brauns.] Autobasic.

The possession of the postpectoral carina, the weakly broken but strongly reclivous nervellus, and the large head are suggestive of *Clistorapha* Cushman, but the very small eyes and ocelli, the short antennae, the unseparated clypeus, the lack of notaulices, the ex-carinate and polished propodeum, and the strongly contrasting color pattern of *Barytatocephalus* appear to distinguish it.

The genus is still known only from the two original Hungarian species. Brauns suggested that his two species might be the sexes of the same species, but Shestakov, in describing the male of *sominiger* Brauns, showed them to be distinct.

##### Genus DICTYONOTUS Kriechbaumer

*Dictyonotus* KRIECHBAUMER, Zool. Jahrb. Syst., vol. 8, p. 197, 1894. [Genotype: *Ophion* (*Dictyonotus*) *melanarius* Kriechbaumer.] Monobasic.

Elsewhere in this revision I have indicated the possible synonymy of this genus and *Aglaoophion* Cameron. I have not seen the genotype unless it is perhaps synonymous with *Aglaoophion purpurascens* (Smith), which possibility several of the characters listed by Kriechbaumer would seem to preclude; *melanarius* is considerably smaller than any specimen of *purpurascens* that I have seen, while the coarsely sculptured and mat thorax and sharply defined triangular basal area of the propodeum apparently would distinguish it. Most significant of

all is the fact that the nervellus is said to be broken in the middle, which would exclude *melanarius* not only from *Aglaophion* but from the *Thyreodon* group. Nevertheless, the impression gained from the original description is of an insect of that group, and one suspects that the description of the nervellus is the result of faulty observation. Both *melanarius* and *purpurascens* occur in North China.

Kriechbaumer himself considered *melanarius* more closely related to (*Ophion*) *Stauropoctonus bombycivorus* (Gravenhorst) than to any other European species (of *Ophion*), but stated: "If one does not wish to place this species in the same genus as *bombycivorus* a new genus must be erected for it (perhaps *Dictyonotus*, from *δίκτυον*, net, and *νώτος*, back)."

#### Genus EURYCAMPTUS Morley

*Eurycamptus* MORLEY, A revision of the Ichneumonidae based on the collection in the British Museum (Natural History), pt. 1, p. 27, 1912. [Genotype: *Ophion latipennis* Kirby. By designation of Viereck, U. S. Nat. Mus. Bull. 183, p. 57, 1914.]

From the few characters given in the original descriptions of the genus and the genotype as well as some additional characters communicated by Mr. Perkins I am unable to place this genus satisfactorily in the key. Quite obviously it does not belong in the *Thyreodon* group, but the characters known to me divide almost between those of the *Ophion* and *Enicospilus* groups.

The following description of the genotype was sent me by J. F. Perkins. In it I have interpolated a few other characters from the original description; the latter are italicized.

"Occipital carina, centrally, notched towards the neck; mandibles narrowing in apical third (i. e., the posterior margin curving from about two-thirds to apex of tooth); antenna shorter than length of fore-wing; pronotal sinus broad; scutellum unmarginated; postscutellum with a very deep basal depression; speculum narrow, very sharply defined ventrally and ventro-posteriorly by a deep depression; sternauli deep, extending three-fourths distance to apex, where they are closed by broad carinae; a deep furrow before middle coxae; postpectoral carina very broadly interrupted, present only laterally and as a high costa closing mesosternal furrow posteriorly; *propodeum with a median longitudinal carina*, basal constriction deep, with median and lateral foveae very weakly differentiated; stigma narrow, about same width as in *Stauropoctonus*, but shorter; basal abscissa of radius weakly sinuate centrally, meeting stigma at an angle of about 45°, weakly though distinctly thickened in basal half; apical abscissa weakly arched towards the costa basally, curved apically to anterior margin; fenestra present but extremely narrow, joining the smooth area beneath stigma; basal abscissa of radius in hind wing curved,

weakly sinuate and thickened in basal two-thirds; *abdomen stout*; umbo absent; spiracles of second tergite at middle."

The genus probably belongs in the *Enicospilus* group, because of the present, though interrupted, postpectoral carina; very narrow and elongate stigma; sinuate and basally thickened basal abscissa of radius; the possession of the fenestra, though this apparently is unusually small and narrow; and the lack of the umbo on the second tergite.

Nearly as convincing reason for placing it in the *Ophion* group is found in the broad pronotal sinus; the unmarginated scutellum; the sharply defined speculum; the divided basal constriction of propodeum; the curved abscissula; and the location of the second tergal spiracles at the middle of the tergite. In addition to the characters that it shares with the *Ophion* group it differs further from the *Enicospilus* group by the peculiar form of the mandible.

According to Mr. Perkins the American species described in *Eurycamptus* Morley do not belong there, *E. novascotiae* being an *Ophion*. He did not indicate in his notes to what genus *E. flavipennis* belongs, merely stating that it is not *Eurycamptus* and "differs from *Enicospilus* as follows: Occipital carina narrowly interrupted centrally; pronotal sinus open; speculum set off below by an oblique furrow; postpectoral carina narrowly interrupted centrally; second tergite with spiracle a little beyond middle, as far removed from lateral margin as half the distance between the spiracle and the hind margin, the epipleura, however, narrow; abdomen not strongly compressed, petiole broader than deep, postpetiole about twice as broad as deep; scutellum unmarginated." Except that the occipital and postpectoral carinae are present, though interrupted, and that Mr. Perkins did not mention the trochanteral tooth, I would suspect that *flavipennis* is a species of *Aulophion*.

#### Genus PLATOPHION Hellén

*Platophion* HELLÉN, Acta Soc. Faun. et Flor. Fennica, vol. 56, No. 6, p. 14, 1926.—

SCHMIEDEKNECHT, Opuscula ichneumonologica, Suppl. 24, p. 25, 1935.

[Genotype: *Ophion areolaris* Brauns. By present designation.]

Described as a subgenus of *Ophion* and also so treated by Schmiedeknecht, this was differentiated from the typical subgenus only by the medially interrupted occipital carina and by the large, subquadrate scutellum. According to notes by J. F. Perkins the genus entirely lacks the occipital carina; the basal constriction of the propodeum is weakly though evidently divided; the speculum is strongly convex, but not margined anteriorly by a distinct groove; the first recurrent vein is strongly convergent with the basal; and the nervellus is very long.

These characters seem to indicate a relationship to *Stauropogon* and *Aulophion*, and I should not be surprised if it is really a synonym

of the former. But information as to the possession or lack of the teeth on the apical trochanteral joints is lacking, and I prefer for the present to treat *Platophion* in the category of unplaced genera.

#### Genus STENOPHTHALMUS Szépligeti

*Stenophthalmus* SZÉPLIGETI, in Wytsman, Genera insectorum, fasc. 34, p. 23, 1905.—SCHMIEDEKNECHT, Opuscula ichneumonologica, fasc. 18, p. 1425, 1908.—SHESTAKOV, Konowia, vol. 5, p. 256, 1926. [Genotype: *Stenophthalmus algiricus* Szépligeti. By designation of Viereck, U. S. Nat. Mus. Bull. 83, p. 137, 1914.]

*Psylonychia* SZÉPLIGETI, in Wytsman, Genera insectorum, fasc. 34, p. 23, 1905. [Genotype: *Stenophthalmus algiricus* Szépligeti. By present inclusion and designation.] New synonymy.

The name *Psylonychia* occurs only in the description of the subfamily Ophioninae, and it is evident that Szépligeti at first intended to use this name for what he actually described as *Stenophthalmus*.

As pointed out by Shestakov, Schmiedeknecht inadvertently referred *Hellwigiella nigripennis* Szépligeti and *H. similis* Szépligeti to *Stenophthalmus*.

So far as the few characters given for this genus go, it evidently belongs to the *Ophion* group, and I doubt its distinctness from *Ophion*. Certainly the key characters of small eyes and ocelli are not sufficient to separate it.

#### GENERA WRONGLY INCLUDED IN THE OPHIONINI

##### Genus ANOMALON Panzer (NOTOTRACHYS Marshall)

Virtually all authors have employed the name *Nototrachys* for this genus, but Rohwer, Gahan, and Cushman (Proc. Ent. Soc. Washington, vol. 17, p. 149, 1915) showed that it should be known as *Anomalon*.

Because of the position of the second recurrent vein basad of the intercubitus Morley included this genus, under the name *Nototrachys*, in the Ophionini, despite the many characters that exclude it from that tribe. The combination character of the single calcarium of the middle tibia, together with the venational character, the unbroken nervellus, the swollen front and middle tibiae, the tooth at the apex of the front tibia, the simple claws, the convergent eyes and the strong epomia I consider sufficient for tribal distinction. This conclusion is supported by the host relation with the larvae of elaterid beetles (*Heteroderes*) and by larval characters, as shown on earlier pages of this revision.

##### Genus OPHIONONEURA Cameron

*Ophiononeura* CAMERON, Rec. Albany Mus., vol. 1, p. 174, 1904. [Genotype: *Ophiononeura flavomaculatus* Cameron.] Monobasic.

*Ophioneura* CAMERON, Ann. South African Mus., vol. 5, p. 84, 1906.—SCHMIEDEKNECHT, Opuscula ichneumonologica, fasc. 18, pp. 1424, 1453, 1908. Emendation of *Ophiononeura*. Autobasic with *Ophiononeura* Cameron.

**Genus ERYTHROPHION Cameron**

*Erythrophion* CAMERON, Ann. South African Mus., vol. 5, p. 87, 1906.—SCHMIEDEKNECHT, Opuscula ichneumonologica, fasc. 18, pp. 1424, 1453, 1908. [Genotype: *Erythrophion ferrugineus* Cameron.] Monobasic.

**Genus STICTOPHION Cameron**

*Stictophion* CAMERON Ann. South African Mus., vol. 5, p. 85, 1906.—SCHMIEDEKNECHT, Opuscula ichneumonologica, fasc. 18, pp. 1424, 1454, 1908.

The above three genera, all based on South African species, were originally placed in the Ophionini and later transferred by Schmiedeknecht to the (Nototrachini) Anomalini, with which the unicalcarate middle tibia, simple claws, bidentate clypeus, rugose mesoscutum, long ovipositor, short wings, and unbroken nervellus, ascribed at least to *Ophiononeura* and *Erythrophion*, would ally them. To these characters, mentioned in the original descriptions, I am enabled, through the kindness of J. F. Perkins, to add the following:

*Ophiononeura*.—Eyes slightly convergent and not emarginate; epomia complete; foretibia with an apical tooth; second recurrent antefurcal by one and one-half times the length of intercubitus; angle between basal abscissa of radius and intercubitus about 150°.

*Stictophion*.—Eyes, epomia, and foretibia as in *Ophiononeura*; second recurrent antefurcal by one and one-third times the length of intercubitus; angle between basal abscissa of radius and intercubitus about 120°.

*Erythrophion*.—Eyes, epomia, and foretibia as in *Ophiononeura*; second recurrent antefurcal by slightly more than length of intercubitus; angle between basal abscissa of radius and intercubitus about 150°.

These added characters taken together with those furnished by the original descriptions render the placing of these genera in the Anomalini obvious.

Schmiedeknecht's statement, in his key to the genera of the Nototrachini, that the second recurrent vein is apical of the intercubitus is due to his misinterpretation of Cameron's statement "the recurrent nervure received behind the transverse cubital." It seems probable that this character was Cameron's sole reason for placing the genera in the Ophionini.

**Genus TRACHYOPTERUS Morley**

*Trachyopterus* MORLEY, A revision of the Ichneumonidae based on the collection in the British Museum (Natural History), pt. 1, p. 67, 1912. [Genotype: *Trachyopterus primus* Morley.] Monobasic.

According to J. F. Perkins this genus belongs in the Anomalini. To the very brief and inadequate description Mr. Perkins adds the following characters: "Eyes convergent and not emarginate; epomia

complete; second recurrent antefurcal by the length of intercubitus; angle between basal abscissa of radius and intercubitus about  $120^\circ$ ."

#### Genus GRAVENHORSTIA Boie

*Gravenhorstia* BOIE, Arch. Naturg., vol. 2, p. 42, 1836.—ASHMEAD, Proc. U. S. Nat. Mus., vol. 23, p. 86, 1900.—SZÉPLIGETI, in Wytzman, Genera insectorum, fasc. 34, p. 24, 1905.—SCHMIEDEKNECHT, Opuscula ichneumonologica, fasc. 18, p. 1427, 1908.—MORLEY, British Ichn., vol. 5, p. 259, fig., 1914.—CEBALLOS, Himenopteros de Espana, Ichn., p. 177, fig. 123, 1925. [Genotype: *Gravenhorstia picta* Boie.] Monobasic.

*Odontopsis* FOERSTER, Verh. naturh. Ver. preuss. Rheinlande, vol. 25, p. 150, 1868. [Genotype: *Gravenhorstia picta* Boie.] Autotypic through synonymy.

This genus has been variously placed in the Ophionini, Campoplegini, and Therionini. As *Odontopsis* it was included in the Campoplegini by Foerster. Ashmead synonymized *Odontopsis* with *Gravenhorstia* and placed it in the Ophionini, in which he has been followed by Szépligeti and by Schmiedeknecht. Morley and Ceballos relegate it correctly to the Therionini (Anomalini), with which placing J. F. Perkins (*in litt.*) concurs.

#### Genus KOKUJEWIELLA Shestakov

*Kokujewiella* SHESTAKOV, Konowia, vol. 5, p. 257, 1926. [Genotype: *Kokujewiella vicaria* Shestakov.] Monobasic.

This genus almost certainly belongs in the Therionini, as indicated by the nearly interstitial second recurrent vein, the simple claws, the convergent eyes and the black and yellow color pattern of the genotype. The author himself compares it with *Gravenhorstia*.

#### Genus OPHIOPTERUS Brullé

*Ophiopterus* BRULLÉ, Histoire naturelle des insectes, Hyménoptères, vol. 4, p. 153, pl. 42, fig. 5, 1846.—CRESSON, Proc. Acad. Nat. Sci. Philadelphia, 1873, p. 380.—CAMERON, Biologia Centrali-Americana, Hymenoptera, vol. 1, p. 296, 1886.—SZÉPLIGETI, in Wytzman, Genera insectorum, fasc. 34, p. 37, 1905.—SCHMIEDEKNECHT, Opuscula ichneumonologica, fasc. 18, p. 1424, 1908.—HOOKER, Trans. Amer. Ent. Soc., vol. 38, p. 92, 1912. [Genotype: *Ophiopterus coarctatus* Brullé.] Monobasic.

*Ophiophterus* Brullé, ASHMEAD, Proc. U. S. Nat. Mus., vol. 23, p. 87, 1900.—MORLEY, A revision of the Ichneumonidae based on the collection in the British Museum (Natural History), pt. 1, p. 66, 1912. Emendation of *Ophiophterus* Brullé. Autobasic with *Ophiophterus* Brullé.

This genus has consistently been placed in the Ophionini solely because of the position of the second recurrent vein basad of the intercubitus. However, in all of the principal characters except this it agrees with the Therionini and to that tribe I assign it. The conformation of the head, with the occipital carina ascending very close to the ocelli and terminating below very close to the articulation of the mandible, the medially produced clypeus and the convergent eyes;

the strong epomia; the minute tooth at the apex of the front tibia, the bicalcarate middle tibia, the simple claws, and the unbroken nervellus are all therionine characters. The strongly rounded and colliformly produced propodeum is exactly like that of *Podogaster* Brullé and *Clatha* Cameron, and the three genera I believe to be closely related.

**Genus PSEUDANOMALON Szépligeti**

*Pseudanomalon* SZÉPLIGETI, in Wytman, Genera insectorum, fasc. 34, p. 33, 1905. [Genotype: *Pseudanomalon gracilis* Szépligeti.] Monobasic.

I have not seen a member of this genus, but despite the antefurcal second recurrent I was inclined to relegate it to the Therionini, in which tribe a few genera have that character, because of the acute clypeus, the prolongation of the propodeum over the hind coxae, the low fracture of the nervellus, the long second tergite and the color of the genotype. This placing was confirmed by Mr. Perkins, who adds two therionine characters: front tibia with an apical tooth; occipital carina closer to ocelli than posterior ocelli are to each other.

**Genus RETANISIA Cameron**

*Retanisia* CAMERON, Biologia Centrali-Americana, Hymenoptera, vol. 1, p. 299, pl. 12, fig. 10. 1886.—MORLEY, A revision of the Ichneumonidae based on the collection in the British Museum (Natural History), pt. 1, p. 4 (footnote), 1912. [Genotype: *Retanisia facialis* Cameron.] Monobasic.

Morley correctly disposed of this genus, which was placed originally by Cameron in the Anomalini and transferred by Dalla Torre to the Ophionini in 1902, when he said it "is actually quite closely allied to, if not synonymous with *Acaenitus*, Latr. . . ."

**Genus HELLWIGIA Gravenhorst**

*Hellwigia* GRAVENHORST, Nov. Acta Acad. Nat. Curios., vol. 11, p. 318, pl. 43, 1823. [Genotype: *Hellwigia elegans* Gravenhorst. By designation of Holmgren, Öfv. Vet.-Akad. Förh., vol. 15, p. 321, 1858.]

In his letter transmitting specimens of the genotype Dr. Townes suggested that this genus, despite its anomalous venation and antennae, should be placed in the Campoplegini. With this suggestion I concur. The lack of the first intercubitus and the clavate antennae appear to be mere anomalies, for the whole conformation of the abdomen is distinctly like that of *Campoplegidea*, as are also the unseparated clypeus, the lack of notaulices, the presence of the postpectus, the form and position of the gastrocoeli, the long slender tarsi and calcaria, and even the curvature of the second intercubitus.



## EXPLANATIONS OF PLATES

### PLATE 49

#### *Sclerotized Structures of Heads of Full-grown Larvae*

1. *Thyreodon atricolor* (Olivier).  
*cd*=cardo of maxilla.  
*f*=frontal suture.  
*hy*=hypostomal sclerome.  
*lm*=labium.  
*lp*=labial palpus.  
*md*=mandible.  
*mx*=maxillary sclerome.  
*mzp*=maxillary palpus.  
*oc*=extension from hypostomal sclerome along occipital foramen.  
*sd*=sclerome around opening of silk duct.  
*st*=stipital sclerome.
2. *Enicospilus purgatus* (Say).
3. *Ophion idoneum* Viereck.
4. *Anomalon fuscatum* (Cresson).
5. *Hymenopharsalia foutsii* Cushman.  
*cl*=sclerome across clypeus.
6. *Paranomalon apicale* (Cresson).
7. *Therion morio* (Fabricius).
8. *Heteropelma datanae* Riley, hypostomae and associated sclerotization.

### PLATE 50

#### *Head*

9. *Enicospilus macrurus* (Fabricius).
10. *Enicospilus texanus* (Ashmead).
11. *Agathophiona fulvicornis* Westwood
12. *Alophophion chilensis* (Spinola).
13. *Aulophion bicarinatus* Cushman.
14. *Trophophion tenuiceps* Cushman.
15. *Stauropoclonus chezanus* Cushman.
16. *Enicospilus texanus* (Ashmead).
17. *Boethoneura arida* Cushman.
18. *Clistorapha subfuliginosa* (Ashmead).
19. *Chilophion abnormis* (Felt).
20. *Trophophion tenuiceps* Cushman.
21. *Ophion ancyloneura* Cameron.
22. *Enicospilus purgatus* (Say).
23. *Simophion excarinatus* Cushman.
24. *Genophion costalis* (Cresson).
25. *Rhynchophion flammipennis* (Ashmead).
26. *Potophion caudatus* Cushman.
27. *Trophophion tenuiceps* Cushman.
28. *Agathophiona fulvicornis* Westwood.

### PLATE 51

#### *Propodeum*

- |   |   |
|---|---|
| 29. <i>Thyreodon atricolor</i> (Olivier).   | 31. <i>Rhynchophion flammipennis</i> (Ashmead). |
| 30. <i>Aglaophion purpurascens</i> (Smith). |   |

*Lower Part of Head*

- 32. *Thyreodon atricolor* (Olivier).
- 33. *Athyreodon atriventris* (Cresson).
- 34. *Aglaophion purpurascens* (Smith).
- 35. *Rhynchophion flammipennis* (Ashmead).

PLATE 52

*Mesosternum*

- 36. *Aglaophion purpurascens* (Smith)  
a=prepectus.  
b=postpectus.
- 37. *Athyreodon atriventris* (Cresson).
- 38. *Thyreodon atricolor* (Olivier).
- 39. *Rhynchophion flammipennis* (Ashmead).
- 40. *Enicospilus purgatus* (Say).
- 41. *Ophion ancyloneura* Cameron.
- 42. *Clistorapha subfuliginosa* (Ashmead).

*Propodeum*

- 43. *Ophion ancyloneura* Cameron.  
a-a=basal constriction.
- 44. *Enicospilus purgatus* (Say).  
a-a=basal constriction.

*Thorax*

- 45. *Australophion inflatus* Cushman.

*Mesopleuron*

- 46. *Aglaophion purpurascens* (Smith).
- 47. *Thyreodon atricolor* (Olivier).
- 48. *Simophion excarinatus* Cushman.
- 49. *Aulophion bicarinatus* Cushman.

PLATE 53

*Wings*

- 50. *Thyreodon atricolor* (Olivier).
- 51. *Ophion ancyloneura* Cameron.
- 52. *Enicospilus purgatus* (Say).

PLATE 54

*Portions of Forewing and Hind Wing*

- 53. *Stauropoclonus chezanus* Cushman.
- 54. *Clistorapha subfuliginosa* (Ashmead).  
a=nervellus.
- 55. *Simophion excarinatus* Cushman.  
a=nervellus.
- 56. *Spilophion maculipennis* Cameron.  
b=abscissula and frenulum.  
c=frenulum.
- 57. *Ophiogastrella maculithorax* Brues.
- 58. *Aulophion bicarinatus* Cushman.
- 59. *Chilophion abnormis* (Felt).  
a=nervellus.
- 60. *Abanchogastra hawaiiensis* Ashmead.
- 61. *Enicospilus flavus* (Fabricius).
- 62. *Enicospilus cubensis* (Norton).

## PLATE 55

*Portion of Forewing*

63. *Enicospilus flavoplagiatus* Cushman.
64. *Enicospilus texanus* (Ashmead).
65. *Enicospilus* (*Eremotyloides*) *fullawayi* Cushman.
66. *Enicospilus rufoniger* (Hooker).
67. *Enicospilus* sp., an example of *Atoponeura* Szépligeti.
68. *Enicospilus* (*Pleuroneurophion*) *hawaiiensis* (Ashmead).
69. *Enicospilus americanus* (Christ).
70. *Enicospilus grammospilus* (Enderlein), an example of *Dicamptus* Szépligeti.
71. *Rhopalophion curvus* Seyrig (after Seyrig).

*Humeral Angle of Pronotum*

72. *Thyreodon atricolor* (Olivier).
73. *Ophion slossonae* Davis.
74. *Enicospilus purgatus* (Say).

*Apical Joint of Front Tarsus*

75. *Ophiogastrella maculithorax* Brues.

*Claw*

76. *Rhynchophion flammipennis* (Ashmead).
77. *Spilophion maculipennis* Cameron.
78. *Trophophion tenuiceps* Cushman.
79. *Genophion costalis* (Cresson).
80. *Enicospilus purgatus* (Say).
81. *Ophion ancyloneura* Cameron.
82. *Chilophion abnormis* (Felt).

*Hind Trochanter*

83. *Stauropactonus chezanus* Cushman.

*Apex of Male Abdomen Showing Paramere*

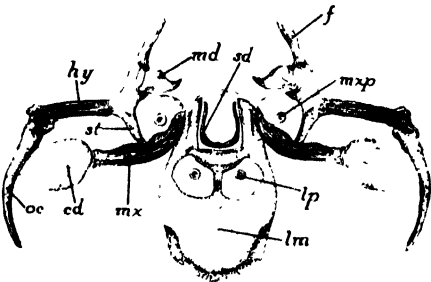
84. *Thyreodon atricolor* (Olivier).
85. *Rhynchophion flammipennis* (Ashmead).

## PLATE 56

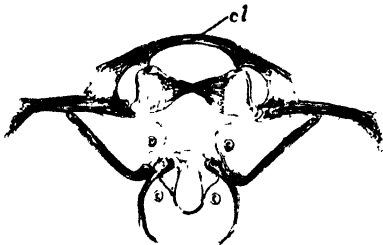
*Abdomen*

- |   |   |
|---|---|
| 86. <i>Thyreodon atricolor</i> (Olivier).       | 95. <i>Genophion costalis</i> (Cresson).  |
| 87. <i>Athyreodon atriventris</i> (Cresson).    | 96. <i>Clistorapha subfuliginosa</i> (Ashmead).                                   |
| 88. <i>Rhynchophion flammipennis</i> (Ashmead). | 97. <i>Chilophion abnormis</i> (Felt).  |
| 89. <i>Aglaophion purpurascens</i> (Smith).     | 98. <i>Agathophiona fulvicornis</i> Westwood.                                     |
| 90. <i>Pycnophion molokaiensis</i> Ashmead.     | 99. <i>Trophophion tenuiceps</i> Cushman.   |
| 91. <i>Potophion caudatus</i> Cushman.          | 100. <i>Enicospilus</i> ( <i>Pleuroneurophion</i> ) <i>hawaiiensis</i> (Ashmead). |
| 92. <i>Simophion excarinatus</i> Cushman.       | 101. <i>Enicospilus purgatus</i> (Say).   |
| 93. <i>Banchogastra nigra</i> Ashmead.          |   |
| 94. <i>Ophion ancyloneura</i> Cameron.          |   |

u=umbo.



1. THYREODON



5. HYMENOPHARSALIA



2. ENICOSPILUS



6. PARANOMALON



3. OPHION



7. THERION



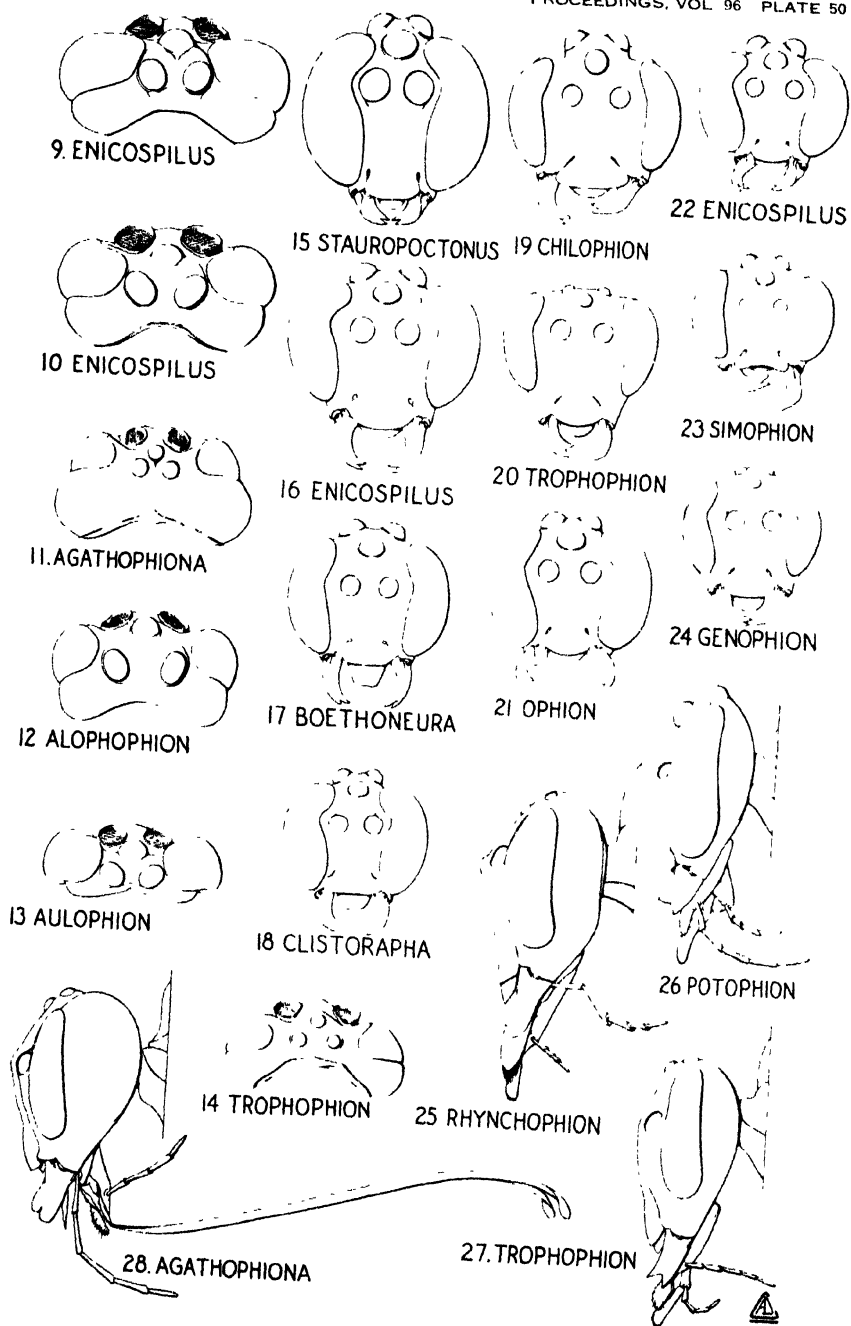
4. ANOMALON



8. HETEROPELMA

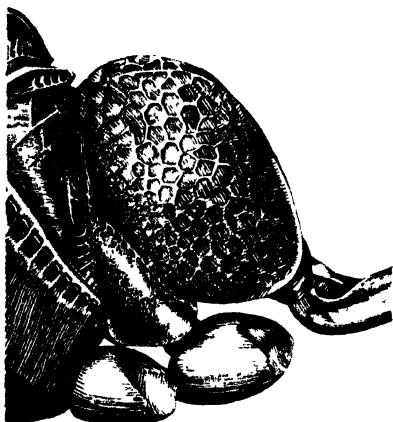
ICHNEUMON-FLIES OF THE TRIBE OPHIONINI

FOR EXPLANATION SEE PAGE 481

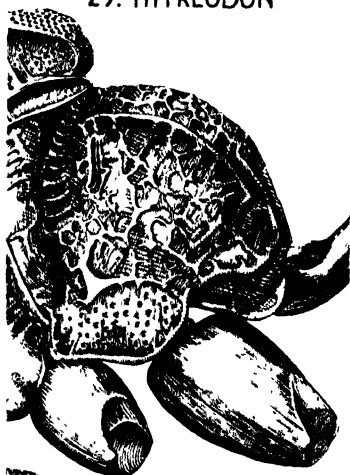


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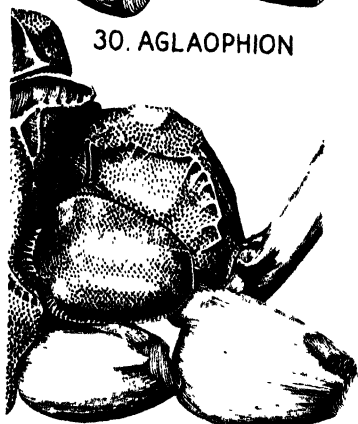
FOR EXPLANATION SEE PAGE 481.



29. THYREODON



30. AGLAOPHION



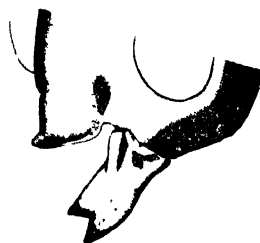
31. RHYNCHOPHION



32. THYREODON



33. ATHYREODON



34. AGLAOPHION

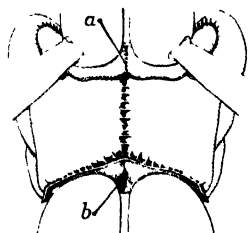


35. RHYNCHOPHION

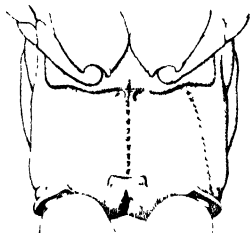


ICHNEUMON-FLIES OF THE TRIBE OPHIONINI

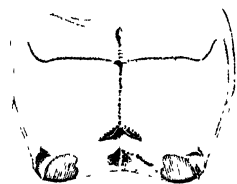
FOR EXPLANATION SEE PAGES 480-481



36. AGLAOPHION



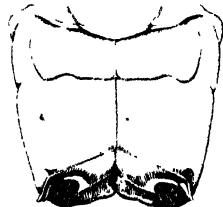
37. ATHYREODON



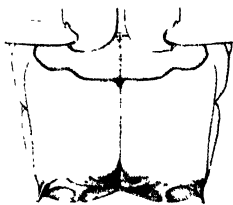
38. THYREODON



39. RHYNCHOPHION



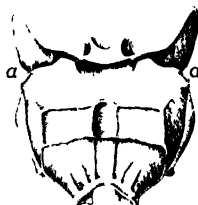
40. ENICOSPILUS



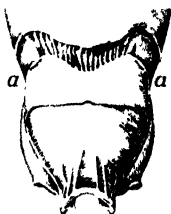
41. OPHION



42. CLISTORAPHA



43. OPHION



44. ENICOSPILUS



45. AUSTRALOPHION



46. AGLAOPHION



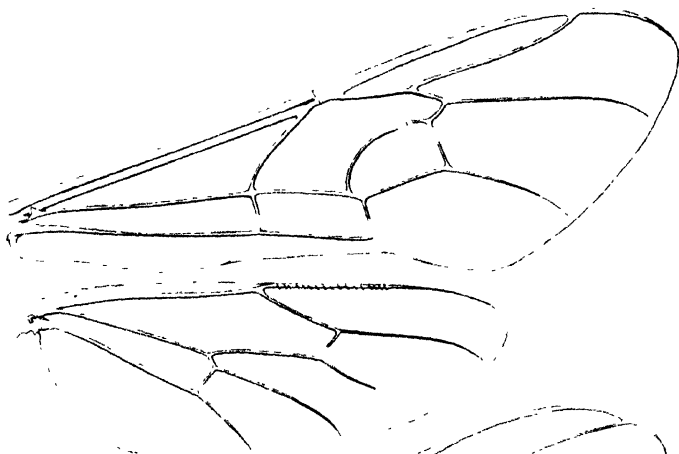
47. THYREODON



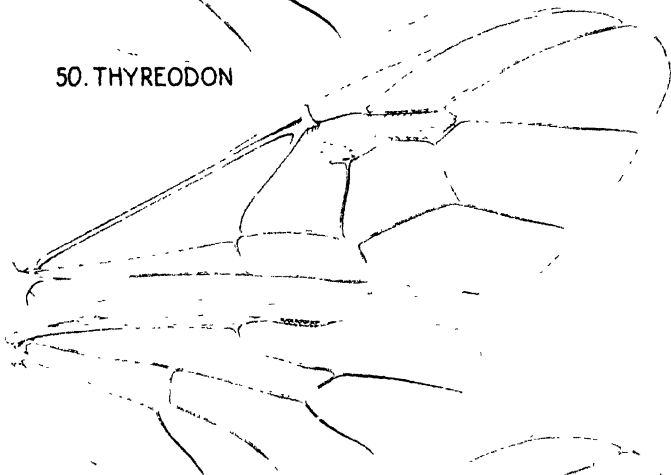
48. SIMOPHION



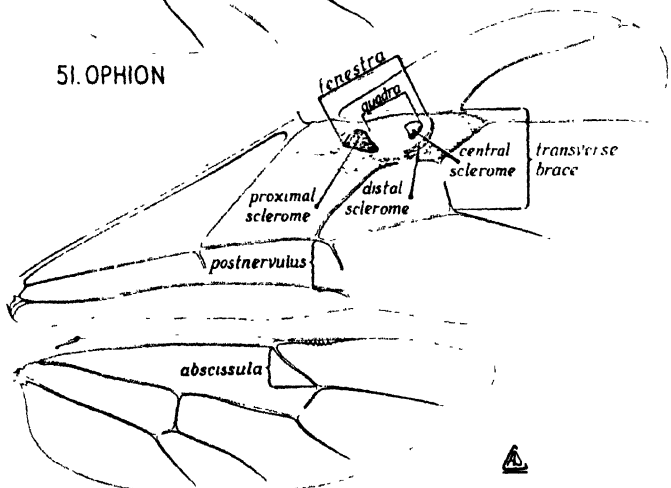
49. AULOPHION



50. THYREODON



51. OPHION

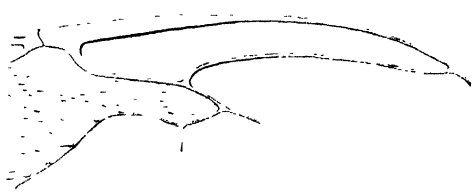


52. ENICOSPILUS

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53 STAUROPOGONIUS



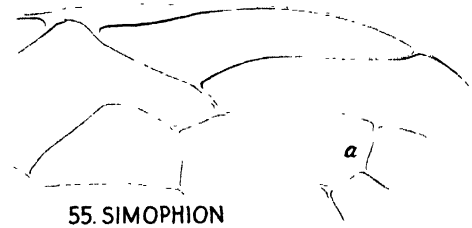
58. AULOPHION



54 CLISTORAPHA



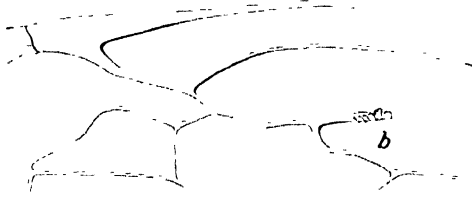
59 CHILOPHION



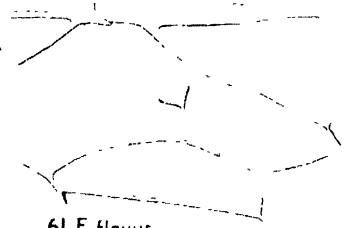
55. SIMOPHION



60. ABANCHOGASTRA



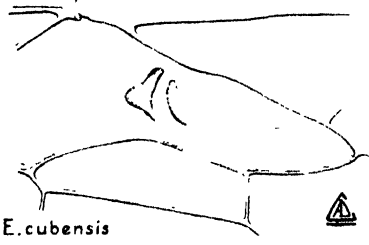
56. SPIOPHION



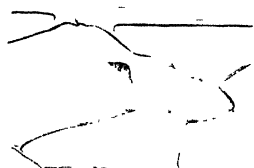
61 E. flavus



57. OPHIOGASTRELLA



62. E. cubensis



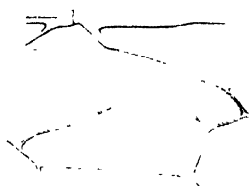
63 ENICOSPILUS flavoplagiatus



69. E. americanus



76 RHYNCHOPHION

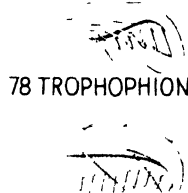


64 E. texanus

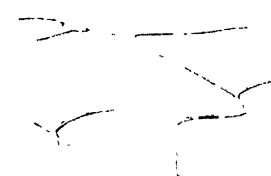


70 E. grammospilus

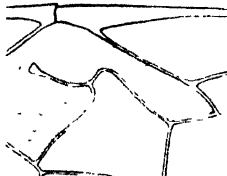
77 SPILOPHION



78 TROPHOPHION



65 E. fullawayi



71 RHOPALOPHION

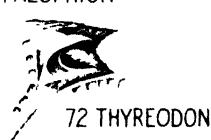
79 GENOPHION



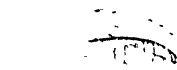
80 ENICOSPILUS



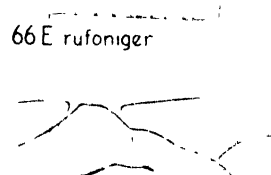
66 E. rufoniger



72 THYREODON



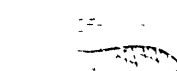
81 OPHION



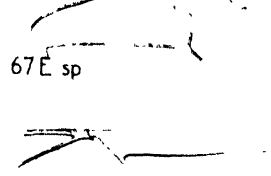
67 E. sp



73 OPHION



82 CHILOPHION



68 E. hawaiiensis



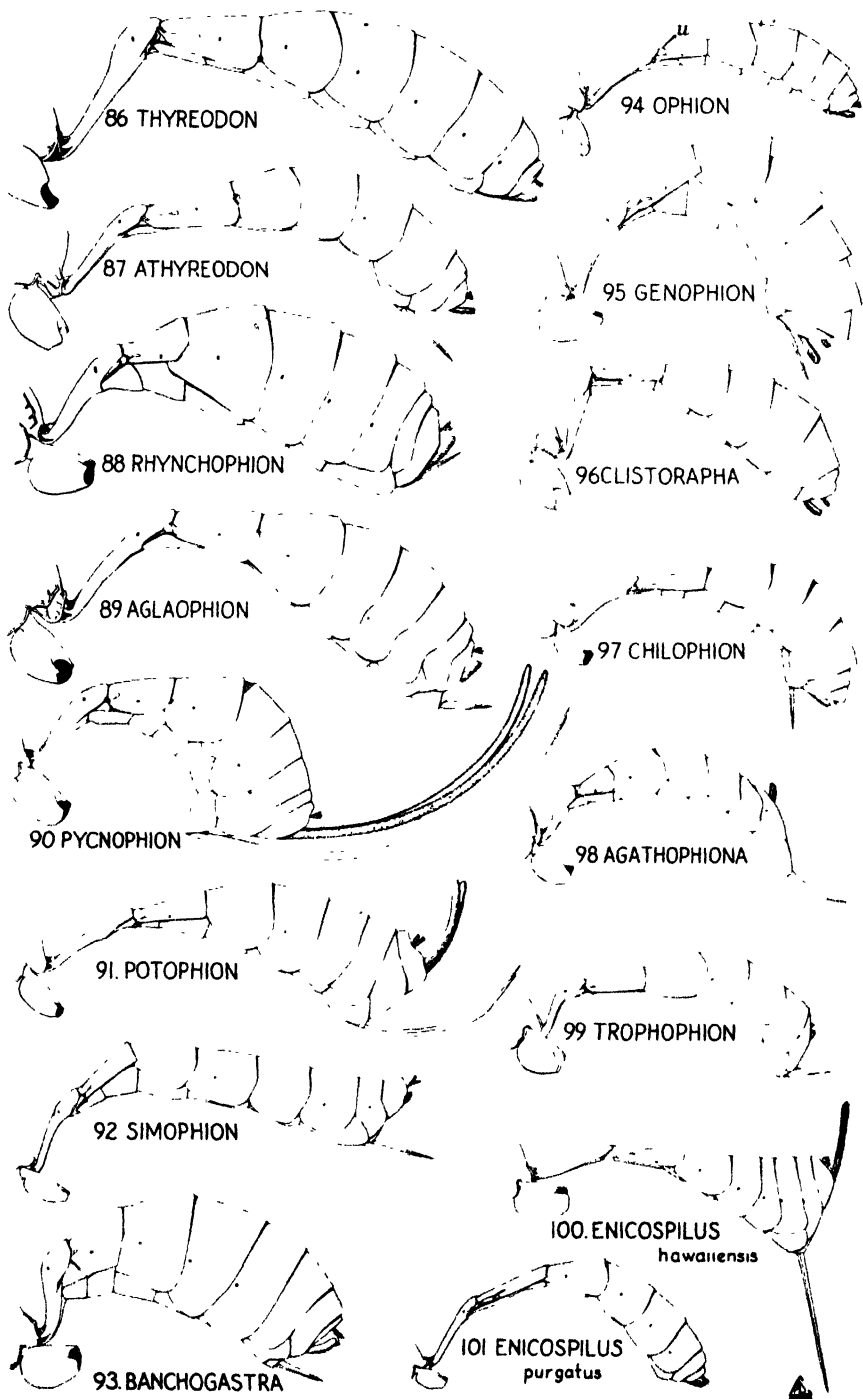
74 ENICOSPILUS

83 STAUROPOCTONUS

75. OPHIOGASTRELLA 84 THYREODON 85. RHYNCHOPHION

ICHNEUMON-FLIES OF THE TRIBE OPHIONINI

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ICHNEUMON-FLIES OF THE TRIBE OPHIONINI

FOR EXPLANATION SEE PAGE 48.



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## REVIEW OF THE WEEVILS OF THE TRIBE OPHRYASTINI OF AMERICA, NORTH OF MEXICO

By A. C. DAVIS<sup>1</sup>

THE present study is the result of an attempt to classify the species of the coleopterous genus *Eupagoderes* in my own collection. Typical and nearly typical specimens are relatively easy to place by the use of existing keys, which depend upon external characters entirely. Many specimens, however, vary so much from the usual condition in size, shape, and vestiture that all attempts to assign them to their proper species are futile. Other specimens fall by the keys into species to which they do not belong, because of the student's unfamiliarity with the amount of variation allowable in certain characters.

In such instances, before any further progress can be made in identification, it is necessary to go beyond the external characters commonly employed and find, if possible, at least one definite char-

<sup>1</sup> ALONZO CLAYTON DAVIS died on January 4, 1942, at the age of 40. An obituary notice was published in the Proceedings of the Entomological Society of Washington, vol. 44, pp. 33-37, March 1942. For several years before his death Mr. Davis had been working, chiefly during spare time, on a revision of the New World species of the large flightless weevils comprising the tribe Ophryastini, which, in the Junk-Schenkling catalog, is placed in the subfamily Leptopinae. The group is almost entirely confined to two regions of the world: Western North America from southern Canada (Medicine Hat, Alberta) into Mexico, where 7 genera and about 65 species occur; and Asia, from which the single genus *Deracanthus*, with 27 described species, is recorded. The group is best developed in the southwestern part of the United States. So far as is known only one New World species, and this of doubtful relationships, occurs south of Mexico, namely, "*Ophryastus hispidus* Latreille," from "Südamerika."

After Mr. Davis' death, L. J. Bottimer gathered together a mass of manuscript, notes, and loose drawings, which represent the progress made by Davis in his study of the Ophryastini. In putting these in order I have added type localities and indicated genotypes, so far as the latter could be determined from the literature; and I have made various minor changes and corrections, none of which materially affects the main conclusions, and none of which seemed of sufficient importance to call for individual comment. In addition, certain points that require explanation, as well as a few more or less extensive alterations in the text, are differentiated by enclosure in brackets. Davis had studied several Mexican species, and his notes on these are, in general, well advanced. Unfortunately they lack certain essentials which it is not now practicable to supply, and his treatment of the Mexican forms (excepting two species of *Tessates*) has, therefore, been omitted.—L. L. BUCHANAN.

acter by which each species may be recognized regardless of the amount of variation in other respects, or a character by which the group may be subdivided. In the Ophryastini the genitalia, especially those of the female, were found to be of value in grouping related species, and often in distinguishing individual species.

I agree with Ferris (1928, pp. 66-69) in his remarks upon the shortcomings of a system that makes more or less of a fetish of perfect specimens when their complete dismemberment may enhance their value greatly from a standpoint of accessibility and scientific study, and in his statement that the use of any point of structure, anatomy, and physiology is legitimate in classification. At the same time the truth remains that in any systematic study a compromise must be made between the ideal and the possible or practical. For example, in *Eupagoderes* the male internal sac and at least one of the valves of the alimentary canal show characters of value, though for certain practical reasons these could not be used in the present study. A similar compromise must be made with illustration, the quality of the drawings being determined by the artistic ability of the writer or by the availability of an artist trained for scientific drawing.

Through the courtesy of J. N. Knull, of the University of Ohio, Dr. R. H. Beamer, of the University of Kansas, E. T. Cresson, of the Academy of Natural Sciences of Philadelphia, Gilbert Arrow, of the British Museum, L. J. Muchmore and Dr. J. A. Comstock, of the Los Angeles Museum, and Dr. E. A. Chapin, of the United States National Museum, I have been able to study all or part of the material in their respective institutions. Thanks are due also to Dr. E. C. Van Dyke, of the University of California, for comparison of specimens with his types, and to Dr. P. J. Darlington, Jr., of the Museum of Comparative Zoology, for comparing specimens with types in the LeConte collection. I am especially indebted to H. C. Fall, of Tyngsboro, Mass., and to L. L. Buchanan, of the Division of Insect Identification, Bureau of Entomology and Plant Quarantine, U. S. Department of Agriculture, for loan of material, assistance, advice, and criticism.

The type specimens of the species of Ophryastini are scattered from England to California, and although an earnest effort was made it was impossible to see them all. In some cases dissection of the type was not desirable, even when it was available. For these reasons two keys were sometimes made, one based upon the genitalia as far as known at present, and the other based upon external characters. The species not examined have been placed in the keys as accurately as possible from published descriptions.

Genitalia were prepared for study in the following manner: The thoroughly relaxed specimen was held beneath the dissecting microscope between the thumb and a finger of the left hand, ventral side

up. The abdominal segment closing the anal aperture was lifted up and back, and a finely pointed scalpel made from a needle was inserted. A cut on each side from the vicinity of the posterior coxae, the edge of the scalpel pressing against the inner side of the abdominal segments and outward against their inturned edges, severed the semi-membranous dorsal sclerites. The scalpel was then brought to the center, close along the ventral plates and the flat side of the blade pressed inward until the internal parts came free of the ventral plates. A transverse cut at about the line of the posterior coxae severed the internal parts completely and the whole viscera posterior to this point could then be lifted out. The ventral segments were then replaced, no damage being done to the appearance of the specimen in most instances.

The internal parts were then dropped into 10 percent potassium-hydroxide solution and left for two hours or more. In species having lightly chitinized genitalia, such as *Eupagoderes decipiens* and *Rhigopsis* spp., this was sufficient, but heavily chitinized genitalia such as those of *Eupagoderes desertus* required soaking in the solution for some hours, then boiling in it, by which process the specimens were not harmed. Having been cleaned and cleared sufficiently, the genitalia were placed in water or acetic acid and examined under a dissecting binocular. Some were completely dismembered, all parts being dissociated for detailed study. Others were preserved complete. Several hours of soaking in acetic acid alcohol neutralized any remaining traces of potassium hydroxide, and the genitalia were then mounted dry upon points beneath the specimens or were placed in minute vials of glycerine similarly pinned beneath the specimens.

Drawings were made with a camera lucida, the outlines and principal structures being traced and the details filled in later under a low-power binocular. In most cases the setae were left out of the drawings as obscuring the detail and serving no useful purpose in separating the species.

The nomenclature of the various parts of the genitalia is more or less of a combination. Names that seemed to apply well have been adopted where found. Those of the male genitalia are largely from Sharp and Muir (1912) and those of the female genitalia partly from Tanner (1927) and partly from Dobzhansky (1931). Some names have been made up where they could not be found readily in literature. Since the present study is not one of phylogeny or homology, but is merely an attempt to distinguish the genera and species of a limited group, descriptive terms should be considered to mean no more than convenient words for reference. The following are the terms used, with a brief explanation of each (the letters in parentheses are those used in fig. 49):

*Apical plates* (AP): Large, dorsolateral, heavily chitinated, finlike plates upon the apex of the female genital tube (fig. 49, *a*, *b*).

*Baculi*: Rodlike structures of heavy chitin between the other plates of the female genital tube. These sometimes act as supports

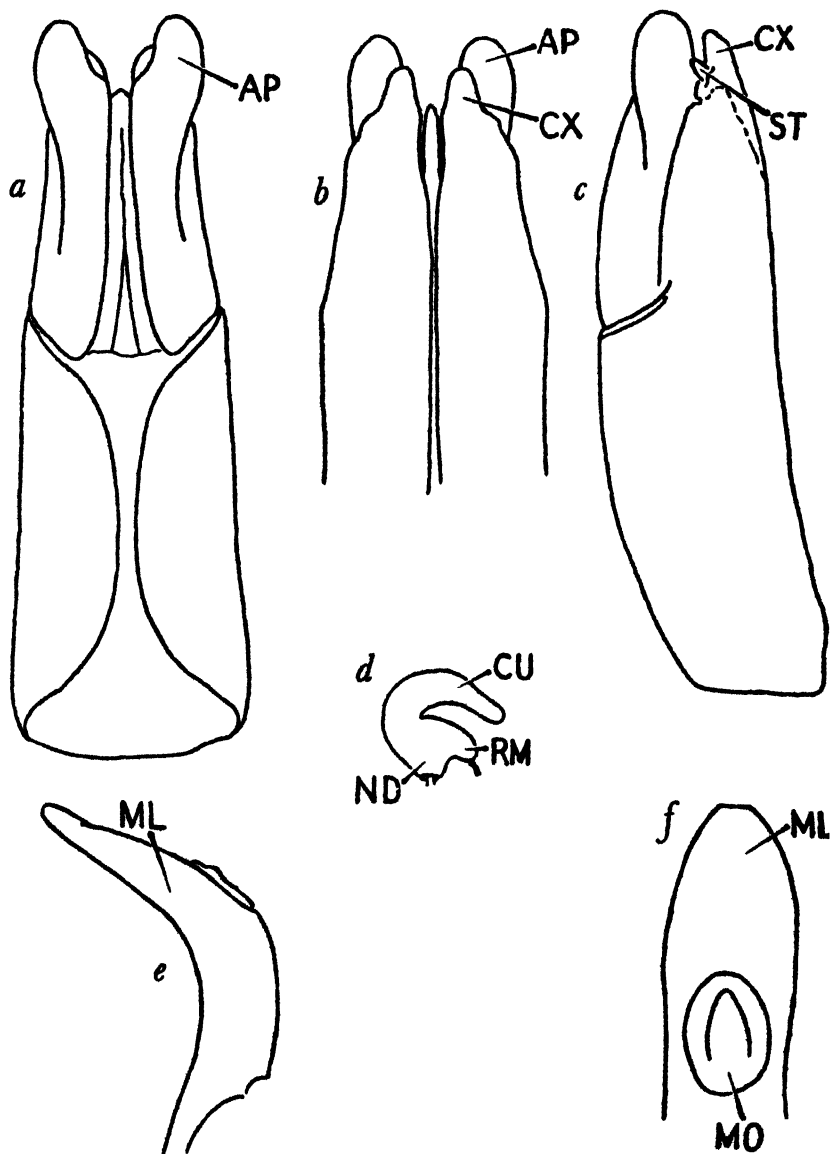


FIGURE 49.—Genital structures of *Eupagoderes* cf. *desertus-californicus* section: *a*, Female genital tube, dorsal view; *b*, female genital tube, ventral view; *c*, female genital tube, lateral view (dorsum to left); *d*, receptaculum seminis; *e*, median lobe of male genitalia, lateral view; *f*, median lobe of male genitalia, dorsal view. See text (pp. 486–487) for further explanation.

in cases where the genital tube is lightly chitinized, as in *Eupagoderes decipiens*.

*Coxites* (CX): Ventral appendages on either side of the apex of the female genital tube, presumably borne by the tenth segment, and carrying the styli (fig. 49, *b, c*). They are generally lobelike, but occasionally they broaden into plates, and may take the place of the apical plates, which then usually become lobelike.

*Cornu* (CU): Part of the receptaculum seminis (fig. 49, *d*).

*Genital tube*: The tubelike protrusible portion of the female genitalia.

*Median lobe* (ML): The central portion of the aedeagus upon which the median orifice is situated. Usually considered the penis (fig. 49, *e, f*).

*Median orifice* (MO): The opening upon the dorsal surface of the median lobe through which the internal sac is evaginated (fig. 49, *f*).

*Nodulus* (ND): Part of the receptaculum seminis (fig. 49, *d*).

*Ramus* (RM): Part of the receptaculum seminis (fig. 49, *d*).

*Receptaculum seminis*: Divided into the cornu (CU); nodulus (ND); and ramus (RM) (fig. 49, *d*).

*Styli* (ST): Cercuslike appendages borne by the coxites (fig. 49, *c*).

The Ophryastini are characterized briefly as follows:

Ocular lobes present, partially covering the eyes, which are usually elongate, transverse, and acuminate beneath. Mentum large, covering the maxillae (except in *Caccophryastes* Sharp, in which the palpi project beyond the mentum). Antennal scrobe well defined, lateral, directed beneath the eye. Rostrum robust, quadrangular, its dorsal surface often with three longitudinal grooves or striae, a median one, and one each side of the median, the two latter called lateral striae, lateral grooves, or lateral sulci.

The New World genera of the Ophryastini may be separated by the following key, which is a modification of the one by Pierce (1913, pp. 373-374):

#### KEY TO NEW WORLD GENERA OF OPHRYASTINI

1. Abdomen with second segment rarely as long as the third and fourth together, first suture straight. Intercoxal process of abdomen moderately wide. 2
- Abdomen with second segment longer than the third and fourth together, first suture strongly arcuate. Intercoxal process very broad..... 8
2. Third tarsal joint pubescent beneath, broadly bilobed, distinctly wider than second..... 3
- Third tarsal joint not pubescent beneath, not broadly bilobed, not or only slightly wider than second, emarginate at apex; rostral striae straight. 7
3. Rostral striae narrow, deep (though often partially obscured by the dense coating of scales), the lateral ones abruptly bent outward at base of beak, thence extending downward on side of beak, and ending next to eye near upper, basal edge of scrobe; basal margins of elytra elevated; second segment of abdomen nearly as long as the third and fourth combined....*Sapotes* Casey



- Rostral striae, when present, relatively coarser and shallower, and confined to dorsal surface..... 4
4. Rostral striae evident, straight; second abdominal segment plainly shorter than the third and fourth combined..... 5
- Rostral striae obsolete, indicated by faint depressions only; second abdominal segment subequal to the third and fourth combined..... 6
5. Mentum concealing palpi entirely..... *Eupagoderes* Horn
- Palpi projecting beyond apex of mentum (Mexico).
- Caccophryastes* Sharp: Genotype, *C. lineatus* Sharp (monobasic)
6. Spinules at apex of fore tibia rather coarse, forming a row which is usually broadly interrupted near upper apical angle..... *Amydrogmus* Pierce
7. Prothorax more or less tuberculate at sides and little, if any, narrower than elytra; apex of hind tibia with two rows (one of which is usually much confused) of spinules, enclosing an elongate space.

*Ophryastes* Schoenherr

- Prothorax not tuberculate at sides, much narrower than elytra; apex of hind tibia with only one distinct row of spinules..... *Tosastes* Sharp
8. Third tarsal joint emarginate, spinulose beneath, scarcely (hind tarsus) or only moderately (front tarsus) broader than second..... *Rhigopsis* LeConte

The foregoing key appears to be about as satisfactory as any that can be devised. Perhaps the greatest single difficulty is with *Tosastes coarctatus* Champion, in which the prothorax is distinctly tuberculate at the sides and as wide as the elytra, the species in these respects displaying tendencies similar to *Ophryastes*. *Sapotes*, *Amydrogmus*, and *Rhigopsis* are well marked. The genus *Caccophryastes* should be recognizable, unless, as Sharp (1891, p. 92) suggests, it is based upon a malformed specimen of a species properly belonging in one of the other genera. The characters given for the separation of *Eupagoderes*, *Ophryastes*, and *Tosastes* should be used with caution, as these genera intergrade with one another to a considerable extent.

Genus *SAPOTES* Casey

*Sapotes* CASEY, 1888, p. 241. (Genotype, *Sapotes puncticollis* Casey, monobasic.)

This genus is characterized by Casey as follows:

Beak about as long as the head, trisulcate; scrobes narrow, deep, beginning near the apex, passing rapidly beneath, vanishing slightly below and before the eyes; the latter broader than long, subacute beneath, partially concealed in repose by the ocular lobes. Antennae short; scape a little shorter than the funicle, barely attaining the eyes, gradually, feebly clavate; funicle seven-jointed, first joint as long as the next two together, second nearly twice as long as the third, joints three to six equal, subquadrate, seventh a little wider, transverse, rather close to the club; the latter ovoidal, pointed, rather small, finely pubescent. Prothorax without lateral tuberosities; ocular lobes well developed, devoid of fimbriae. Scutellum small, triangular, distinct. Tenth elytral stria distinct in basal third. First abdominal segment much longer than the metasternum, nearly as long as the next three together, separated from the second by a very feebly arcuate, deeply impressed suture; second nearly as long as the third and fourth together. Tarsi rather robust; first three joints short, setose with the tips spinose beneath; third slightly wider than the second, bilobed; fourth nearly as long as the first three

together; claws long, divergent. Cotyloid surface of the posterior tibiae semi-cavernous, having a long outer and a short inner line of short, very robust spinules; spurs obsolete.

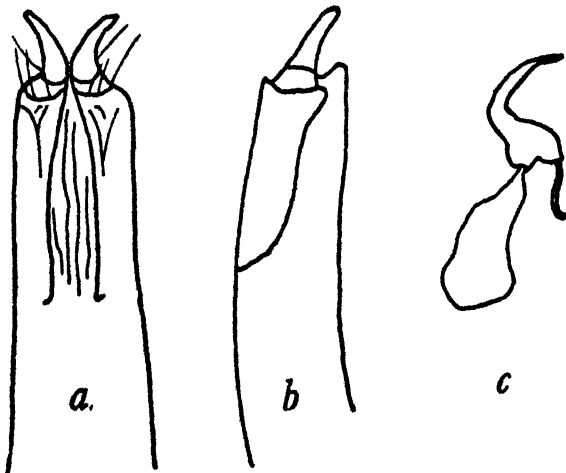
As pointed out by Pierce (1909, p. 341) and Van Dyke (1934, p. 175), Casey was in error in saying that the ocular lobes were not fimbriate. This genus is at once separated from the others of the group by the deep, narrow, lateral sulci of the rostrum, turning abruptly outward at the junction of the head and rostrum, and nearly attaining the upper basal edge of the scrobe.

**SAPOTES PUNCTICOLLIS Casey**

**FIGURE 50**

*Sapotes puncticollis* CASEY, 1888, p. 241.

Form more elongate and parallel than most of the others of the tribe. Color brown, front of rostrum and three vittae on pronotum gray, elytra irregularly mottled with darker brown and irrorate with light gray, or black with scattered light gray and darker scales. The scales of the head and pronotum appear tessellate, those of the remainder of the body large and imbricated. Rostrum heavy, somewhat constricted at base beneath, not greatly arched dorsally; median sulcus narrow and deep, from about the middle of the rostrum, usually terminating abruptly at junction of head and rostrum but occasionally carried up onto the front for a short distance; lateral sulci deep, narrow, bent outward at junction of head and rostrum and continuing down the sides of the rostrum nearly or quite to the eyes. Rostrum separated from the front by a vague transverse impression, which is sometimes nearly lacking; head and rostrum distinctly but sparsely and rather finely punctate, and with subrecumbent white or tawny



**FIGURE 50.**—*Sapotes puncticollis* Casey, female genital tube: *a*, Dorsal view; *b*, lateral view; *c*, receptaculum seminis.

setae. The head appears rugose owing to one or two impressed lines running posteriorly from each puncture. Pronotum slightly wider than long (1.5 by 1.1 mm.), base and apex subequal in width, evenly rounded at sides; disk deeply, coarsely, and closely punctate, giving it a reticulate appearance, and with more or less erect setae from finer punctures on the intervals between the larger ones. Elytral striae consisting of rows of large, round, deep, unconnected punctures; intervals subequal in width, nearly flat, each with a single row of long, semierect, tawny setae. Legs stout, front tibiae nearly straight and denticulate within; apices of hind tibiae truncate, with a double row of spines.

*Measurements in millimeters.*—Length 5.0 to 5.5; width 2.0 to 2.6.

*Female genitalia* (fig. 50).—Eighth sternite broadly rounded and hairy at apex. Genital tube long, lightly chitinized, slightly curved downward, with two diverging, heavily chitinized spines at apex. Receptaculum seminis with the cornu very thin, irregular, curved but not hooked, nodulus small.

*Type locality.*—El Paso, Tex.

I have seen specimens of this species from El Paso, Tex.; Deming and Albuquerque, N. Mex.; and Tucson, Ariz. All specimens examined are females.

#### SAPOTES LONGIPILIS Van Dyke

*Sapotes longipilis* VAN DYKE, 1934, p. 175.

This species differs from *S. puncticollis* in the longer setae, narrower, and less robust form, finer rostral sulci, and the finer and more irregular (nonreticulate) punctation of the pronotum. The female genitalia of the two species are identical.

*Type locality.*—Winslow, Ariz.

#### Genus EUPAGODERES Horn

*Eupagoderes* HORN, 1876, p. 32. (Genotype, *Ophryastes speciosus* LeConte, designated by Pierce, 1913, p. 374.)

Although it seems desirable to maintain *Eupagoderes* as a genus, or at least as a subgenus of *Ophryastes*, for convenience in classification, there is actually no character that holds throughout the group. On this point I cannot do better than to quote from Fall (1907, pp. 260–261):

The establishment of *Eupagoderes* by Horn for certain species previously referred to *Ophryastes* has not proved satisfactory, all the characters named being gradational. The most conspicuous of these, taking the species as a whole, is the presence of lateral callosities of the prothorax in *Ophryastes*, but as pointed out by Dr. Sharp in the "Biologia" this cannot be properly regarded as a generic character. The latter author is, however, equally at fault in stating that the two genera may be separated by the presence (*Eupagoderes*) or absence (*Ophryastes*) of adhesive pubescence on the lobes of the third tarsal joints, this character being

a purely sexual one in at least a considerable number of species of both genera and possibly in all.

The character of cavernous or open corbels as used by Lacordaire was pointed out as undependable by LeConte and Horn (1876, p. 32). The latter authors state that the articulating cavities of the hind tibiae become internal in *Eupagoderes*. This matter is not clear to me, and I see no difference between the two genera in that respect. The character of the truncate hind tibia used by LeConte and Horn to define *Eupagoderes* certainly does not hold throughout the genus. The amount of dilation of the tarsal joints is less in some *Eupagoderes* than in some *Ophryastes*. Fall (1907, pp. 260-261; 1910, p. 189) rejected Sharp's character of the presence or absence of adhesive pubescence on the lobes of the third tarsal joints (a character accepted by Pierce) and he was justified in so doing. He accepted with reservations the character of the lateral tuberosities of the thorax, which Sharp had rejected as being unreliable. This seems to be the most reliable character of all, but it is subject to a great deal of variation. If it were a question of absolute presence or absence of tubercles the character would hold, but the distinction is one of indefinite degree. In many if not most specimens of *Eupagoderes argentatus* (LeConte) and *E. marmoratus* Fall, for example, there are small but well-developed and plainly visible lateral tuberosities. On the other hand, some specimens of *Ophryastes* have the lateral tuberosities so poorly developed as to raise serious doubt as to their correct generic assignment, and *O. symmetricus* Fall has none at all. The character of the "straight" rostral sulci in *Ophryastes* does not hold. In *Eupagoderes sordidus* (LeConte,) for example, the lateral sulci are usually nearly straight, while in *Ophryastes vittatus* Say they are usually slightly arcuate. The median sulcus is straight in both genera. A study of both sexes of various species shows no character upon which the genera may be separated, *Ophryastes* breaking up in much the same fashion as does *Eupagoderes* and the genitalia of the two groups forming a fairly complete series. The retention of the two as distinct genera is, therefore, largely a matter of convenience.

The species of *Eupagoderes* have been grouped into two keys. The following rather unsatisfactory key is an enlargement of that of Fall (1910, pp. 193-194), which is based upon external characters. The key contains several species that I have not seen, these being placed as far as possible from the published descriptions. *E. wickhami* and *ocellatus* are included in the key for the benefit of those who prefer to retain them in *Eupagoderes*, although they will be discussed under *Ophryastes*. Because of the great amount of variation in certain characters, some species will be found under more than one heading.

KEY TO SPECIES OF EUPAGODERES<sup>1</sup>

1. Dorsum of rostrum and front continuous, without interruption by a transverse impression at base of rostrum..... 2
- Dorsum of rostrum and front not continuous, but interrupted by a transverse impression at base of rostrum; or (chiefly in species following couplet 25) dorsum of rostrum and front with separate convexities as viewed from the side, giving the appearance of a transverse impression..... 10
2. Rostrum with a well-defined median sulcus..... 3
- Rostrum without a median sulcus..... 7
3. Pronotum finely and sparsely punctate..... 4
- Pronotum more coarsely and closely punctate..... 6
4. Prevailing color of scales chocolate brown, thorax and elytra vittate with white. Length 14.4 to 21.5 mm..... *speciosus* (LeConte)
- Prevailing color of scales white, not or but feebly mottled. Length 11 to 15 mm..... *nivosus* Fall
- Prevailing color of scales plumbeous, gray, or pinkish; more or less conspicuously mottled. Length 6.1 to 12.3 mm..... 5
5. Tibiae not denticulate within..... *sordidus* (LeConte)<sup>2</sup>
- Tibiae, at least anterior ones, denticulate within..... 6
6. Elytra with ocellate plumbeous spots. Length 10-17 mm. *marmoratus* Fall
- Elytra without ocellate spots; length 12 mm or less..... *simulans* Van Dyke
7. Lateral sulci of rostrum short, linear..... 8
- Lateral sulci of rostrum longer, arcuate, convergent basally..... 9
8. Scales light and dark gray, confusedly mottled; elytral striae impressed, finely punctate..... *decipiens* (LeConte)
- Scales white, sometimes feebly mottled with gray; elytral striae extremely finely impressed, feebly and remotely punctate, almost impunctate..... *decipiens* (LeConte), variety *dunnianus* Casey
9. Scales whitish to cinereous, marmorate with darker gray..... *varius* (LeConte)
- Scales pinkish cinereous, feebly mottled with gray; vertex flattened and finely carinate in the type..... *aridus* Fall
10. Elytral striae coarse, with round, usually disconnected punctures; intervals usually elevated, at least between punctures of adjacent rows..... 11
- Elytral striae fine, impressed; intervals usually flat or nearly so, and unequal in width..... 16
11. First joint of antennal funicle of about the same length and breadth as the second..... *lucanus* Horn
- First joint of antennal funicle longer and somewhat wider than the second..... 12
12. Color predominantly cinereous; form more parallel..... 13
- Color not predominantly cinereous, form more robust..... 14
13. Setae long, tawny, numerous..... *wickhami* Sharp
- Setae shorter and sparser..... *ocellatus* Van Dyke
14. Disk of pronotum finely, sparsely punctate..... *desertus* Horn<sup>4</sup>
- californicus* Ting
- Disk of pronotum more coarsely punctate..... 15
15. Elytra greatly inflated; median sulcus of rostrum lacking..... *robustus*, new species
- Elytra less inflated; median sulcus of rostrum present. *argentatus* (LeConte)

<sup>1</sup> Based on external characters.<sup>2</sup> See note at end of *Eupagoderes* section regarding *E. cretaceus* Sharp.<sup>4</sup> [For distinctions between *desertus* and *californicus* see note following discussion of *desertus*.]

16. Pronotum finely punctate..... 17  
 Pronotum more coarsely punctate..... 21
17. Sutural intervals of elytra fulvous. Length 12 to 18 mm.... *mortivallis* Fall  
 Sutural intervals of elytra not fulvous. Length 7 to 12 mm..... 18
18. Scales opalescent..... 19  
 Scales not opalescent..... 20
19. Front of head convex; sulcus of rostrum linear, vague; apices of hind tibiae obliquely narrowed, not truncate..... *setosus* Van Dyke  
 Front of head slightly flattened; median sulcus of rostrum usually lacking; apices of hind tibiae obliquely truncate..... *aeneus*, new species
20. Color whitish to cinereous, marmorate with darker gray.. *varius* (LeConte)  
 Color pinkish cinereous, feebly mottled with gray; vertex flattened and finely carinate in the type specimen..... *aridus* Fall  
 Color gray or brown, even numbered elytral intervals darker.  
*geminatus* Horn<sup>1</sup>
21. Median sulcus of rostrum narrow..... 22  
 Median sulcus of rostrum broad..... 24
22. Rostrum more robust, apex markedly depressed; Texas.. *simulans* Van Dyke  
 Rostrum less robust, apex not so markedly depressed; California..... 23
23. Plumbeous; unicolorous or nearly so.  
*varius* (LeConte), variety *plumbeus* Horn  
 Gray, variously marked with plumbeous or black, even numbered elytral intervals darker..... *geminatus* Horn
24. Median sulcus of rostrum, when present, terminating at junction with head..... 25  
 Median sulcus of rostrum extending onto the front.... *pilosus*, new species
25. Elytral striae not, or feebly, impressed, punctures large, separate.... 26  
 Elytral striae more distinctly impressed, punctures finer..... 27
26. Scaly vestiture white with black or plumbeous ocellate spots; elytral striae not impressed..... *marmoratus* Fall  
 Scaly vestiture black, brown, and white, without ocellate spots; elytral striae slightly impressed at base and apex..... *huachuacae* Van Dyke
27. Rostrum with a median sulcus..... 28  
 Rostrum without a median sulcus..... 31
28. Robust, dorsum flattened..... *griseus*, new species  
 Less robust, dorsum not or very slightly flattened..... 29
29. Lateral rostral sulci linear..... *halli* Van Dyke  
 Lateral rostral sulci arcuate..... 30
30. Form more parallel; elytra confusedly mottled..... *sordidus* (LeConte)  
 Form less parallel; alternate (even) elytral intervals darker.. *geminatus* Horn
31. Scales whitish to cinereous, marmorate with darker gray.. *varius* (LeConte)  
 Scales pinkish cinereous, feebly mottled with gray..... *aridus* Fall

The following key makes use of the female genitalia for dividing the genus into groups; the species of each group are then separated largely upon external characters.

#### KEY TO GROUPS OF EUPAGODERES

Eighth sternite thin, apex rounded, emarginate, or pointed, but not produced.

Female genitalia tubular.

Female genitalia heavily chitinated, apical plate prominent, styli small.  
desertus group, I

<sup>1</sup> Refer to note at end of *Eupagoderes* section regarding *E. utahensis* Tanner and *E. aerispi* Tanner.

- Female genitalia lightly chitinated, apical plates lacking coxites and styli very small.....robustus group, II  
 Female genitalia membranous, with supporting rods of chitin, apical plates extremely small or lacking, styli large.....decipiens group, III  
 Female genitalia wedge shaped.....speciosus group, IV  
 Eighth sternite produced into 2 large teeth, curving down and back.  
 lucanus group, V

### I. DESERTUS group

In the species of this group the genital organ of the female is tubular and it usually has well-developed apical plates and small styli. The median lobe of the males is, in general, robust, heavily chitinated, and moderately curved. All the species in this group have a transverse impression between the base of the rostrum and the front of the head.

#### KEY TO SPECIES OF DESERTUS GROUP

1. Elytral striae coarse, the punctures round and distinct, elytral intervals usually of nearly equal width, and convex.....desertus Horn\*  
 Elytral striae fine and impressed, punctures fine, intervals flat or very slightly convex, alternate intervals usually wider..... 2
2. Pronotum coarsely and closely punctate..... 3  
 Pronotum finely and sparsely punctate..... 4
3. Apical plates of female genital tube rounded on outer edges; median sulcus of rostrum sharply defined; elytral intervals less convex...geminatus Horn  
 Apical plates of female genital tube toothed or irregular on outer edges; median sulcus of rostrum broad, or with small subsidiary sulci; elytral intervals more convex.....griseus, new species
4. Smaller (7 to 10 mm.); brown, usually with coppery iridescence; Utah.....aeneus, new species  
 Larger (12 to 18 mm.); white or light gray with conspicuous fulvous or yellow marking along the sutural intervals; California...mortivallis Fall

#### EUPAGODERES DESERTUS Horn

*Eupagoderes desertus* HORN, 1876, p. 34.

*Eupagoderes giganteus* CHITTENDEN, 1926, p. 169 (new synonymy).

Form robust, convex, dorsum slightly flattened. Color creamy white or slightly yellowish, elytral intervals 2, 4, and 6 slightly darker; a rather narrow median and two rather wide lateral vittae on the pronotum darker, these often feebly defined. Rostrum robust, moderately arched above, not markedly constricted basally beneath; trisulcate, the median sulcus narrow, lateral sulci nearly straight apically, converging sharply at the base of the rostrum. Head and rostrum separated by a well-marked transverse impression. Head smoothly rounded, and, with the rostrum, extremely finely and rather sparsely punctate, with moderately numerous very small white setae. Pronotum one-seventh to one-fifth wider than long, base one-fifth to one-third wider than apex, subobsoletely sulcate at middle, punctuation varying from coarse and moderately sparse to moderately coarse and

\* [See notes on separation of the closely related *Eupagoderes californicus* Ting following discussion of *desertus*.]

very sparse. Elytral striae marked by rows of large, round, non-confluent punctures; intervals convex, 2, 4, and 6 usually slightly wider; setae white, extremely short and fine, arising from the striae punctures and from a fine secondary punctation on the intervals. Legs stout; fore tibiae strongly curved at apex; all tibiae denticulate within; posterior tibiae with a broad, hairy truncation.

*Measurements in millimeters.*—Length 14 to 22.

*Female genitalia.*—Very similar to those shown in figure 49, *a, b, c, d*. Genital tube heavily chitinized, sides nearly parallel; apical plates rather small in proportion, heavily chitinized and tilted so that the outer edges are higher than the inner; coxites lightly chitinized; styli short, conical. Eighth sternite very slightly and broadly emarginate at apex, sides rounded.

*Male genitalia.*—About as in figure 49, *e, f*. Median lobe only moderately sharply curved, heavily chitinized, thick in profile; broadly, obtusely rounded, and truncated at apex as viewed from above; not deeply excavated dorsally; median orifice oval.

*Type locality.*—Of *desertus*, Carisa Creek, on the borders of the Colorado Desert of California. Of *giganteus*, Thermal, Calif.<sup>1</sup>

The type specimen of *desertus* was found dead near Carisa Creek, a branch of San Felipe Creek, in Imperial or San Diego County, Calif. Other California localities are Indio (W. T. Swingle), Holtville (W. Benedict), La Puerta (Ricksecker), and Thermal (A. C. Davis and H. J. Ryan). Specimens have also been seen from Yuma, Ariz. (Herbert Brown).

*Remarks.*—*E. desertus* Horn in average size is probably the largest of the genus. The type, a female specimen, has been at one time covered with mud, and the punctures are still partially filled, giving the specimen a rather smooth appearance. The pronotum is much less heavily punctate than in most specimens. This species has been confused with *E. wickhami* Sharp, from which it may be distinguished by the more robust form and the lighter color.

Examination of the type and two paratypes of *Eupagoderes giganteus* Chittenden shows them to be female specimens of *E. desertus* Horn.

[EUPAGODERES CALIFORNICUS Ting

*Eupagoderes californicus* TING, 1939, p. 81.

*Type locality.*—Stove Pipe Wells, Death Valley, Calif.

*Remarks.*—No mention of this species was found in Mr. Davis's manuscript.

*Eupagoderes californicus* was described from a long series taken at two places in Death Valley—Stove Pipe Wells, and on the west side

<sup>1</sup> [In the original description of *giganteus* the type locality is stated to be Coachella, Calif., but the type specimen and the two paratypes are labeled Thermal. These towns are only a few miles apart.]



of the valley, 20 miles south of Furnace Creek Ranch. The National Museum collection contains several old examples of *californicus* from Death Valley, and two from "Ariz.," all of which were found mixed in with the series of *desertus*; in addition several paratypes of *californicus* are at hand, presented to the National Museum by Mr. Ting. Ting's species is quite distinct from *desertus*, though the two are closely related. Of several characters of *californicus* pointed out by Ting, in which it differs from *desertus*, the following were found especially useful: The more or less distinctly speckled elytra, the shallower serial punctures on the elytra, the obscuring of the tenth row of punctures by the scaly vestiture, the shape of the median lobe of the male genitalia (figured by Ting), and, particularly in the female, the greater convexity of the fifth abdominal sternite. In addition, when the two species are compared in series, *californicus* is seen to be considerably smaller, ranging from 10.5 to 17 mm. in length (teste Ting), whereas *desertus* is from about 14 to 22 mm. long. Davis's redescription of *desertus* was evidently based chiefly on specimens of this species, though included in it were a few statements of exception and qualification that obviously referred to *californicus*. After the elimination of these inapplicable portions, Davis's description fits *desertus* well enough.]

EUPAGODERES GEMINATUS Horn

FIGURE 51

*Eupagoderes geminatus* HORN, 1876, p. 35.

Robust, elytra moderately inflated; color variable but predominantly gray; head usually with a median line and a space in front of each eye dark brown or plumbeous; markings of elytra variable, but usually light gray, intervals 2, 4, and 6 darker. Sometimes interval 1 is also dark. Some specimens are dark gray irrorate with darker gray or black, and others have the even numbered elytral intervals only slightly darker, with irregular paired spots of gray or black in the striae, one on each side of the interval. Specimens from Overton, Nev., have the suture and some of the markings on the head, thorax, and elytra light brown. However marked, the third elytral interval is nearly always conspicuously lighter. Rostrum moderately stout, constricted<sup>8</sup> at base beneath; median sulcus fine, sharp; lateral sulci short, evenly arcuate, sometimes subobsolete. Transverse impression vague, sometimes nearly obsolete. Head rounded, front slightly flattened; head and rostrum finely and sparsely punctate. Pronotum one-fourth or slightly more than one-fourth wider than long, base one-sixth to two-sevenths wider than apex; sides evenly rounded; disk varying from nearly impunctate to coarsely, closely punctate; in

<sup>8</sup> The constriction, in this and in other species, is not always apparent, at least with the scales in place.

the latter case subtuberculate at sides; median impression present. Elytra more or less inflated; two-sevenths to one-third longer than wide, widest at apical three-fifths; truncate at base; striae finely impressed, punctures fine, intervals 3 and 5 usually slightly wider, all intervals usually slightly convex. Legs only moderately stout, fore and middle tibiae usually, but not always, minutely denticulate within, posterior tibiae usually obliquely truncate.

*Measurements in millimeters.*—Length 6.0 to 12.5, averaging about 8.

*Female genitalia* (fig. 51, *a, b, c, d*).—Genital tube tubular, apical plates rather thick, varying in shape as shown in the figures, margins smooth; coxites small, laterally compressed, lightly chitinized, the setae in small bundles rather than single; styli visible from beneath. In profile the “roach-backed” appearance of the dorsal outline apically seems peculiar to this species. The eighth sternite is usually slightly obtusely emarginate at apex, but smoothly rounded in some specimens; sides smoothly rounded.

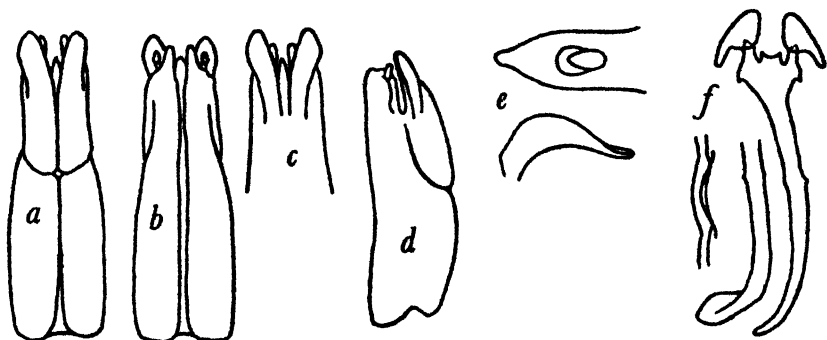


FIGURE 51.—*Eupagoderes geminatus* Horn: *a* and *c*, Female genital tube, dorsal view; *b*, female genital tube, ventral view; *d*, female genital tube, lateral view; *e*, median lobe of male genitalia, dorsal and lateral views; *f*, accessory parts of male genitalia.

*Male genitalia* (fig. 51, *e, f*).—Median lobe heavily chitinized, black; in profile very sharply curved, apex recurved and flattened; moderately deeply excavated dorsally, the margins near the apex sinuate.

The curvature of the median lobe of the male, as well as the degree of sharpness of the tip, is subject to some variation, but the female genital tube seems to vary little except to a minor extent in the degree of sharpness of the apical plates.

*Type locality.*—Owens Valley, Calif. I have the following records of locality: CALIFORNIA, Kern County (Coquillett); Los Angeles County (Coquillett); Lancaster (Wickham); San Francisco (?); Owens Lake (Wickham), Panamint Valley, Argus Mountains, Humboldt Lake (Wickham), Keeler (Wickham), Independence (Wickham), Mojave Desert, Fairmont (A. C. Davis), Fort Tejon (A. C. Davis), Amadee (Wickham), Claremont (W. Benedict), San Bernardino.

NEVADA, Wadsworth, Hawthorne (Wickham), Overton (David E. Fox), Glendale (E. W. Davis).

The San Francisco locality (University of Ohio collection) is probably an error in labeling, or an accidental transportation of specimens from the southern part of the State.

*Remarks.*—This is the most variable species of the genus, as the genital structure is the only character that does not vary tremendously. It may be distinguished easily by the characters given in the key when it has been placed in the proper group by the genitalia of the female.

EUPAGODERES GRISEUS, new species

FIGURE 52

Robust, inflated, dorsum flattened. Color gray, with a median spot on the front, a spot in front of each eye, a narrow median, and two wide lateral vittae upon the pronotum, plumbeous; narrow elongate spots of black along the elytral striae, and diffuse blotches of darker gray upon the elytra. Rostrum moderately stout, arched above and not constricted at base beneath; median sulcus broad, rather shallow, wider apically, or if narrow and finely impressed, with a very fine, subobsolete subsidiary sulcus at each side about one-third of the distance to the lateral sulci; lateral sulci distinct, short. Transverse impression between head and rostrum very vague. Head evenly rounded; head and rostrum finely and sparsely punctate. Pronotum two-sevenths wider than long, widest slightly in front of the middle, base one-sixth to one-fourth wider than apex, subglobose, sides smoothly rounded; disk moderately coarsely and closely punctate, more closely toward the sides, which are subtuberculate in some specimens; median impression deep and distinct, to subobsolete. Elytra moderately inflated, and from three-fourths to two-thirds longer than wide, truncate at base; striae finely impressed, stria punctures distinct; elytral intervals convex, subequal in width. Legs moderately stout, front and middle tibiae usually very minutely denticulate within; posterior tibiae truncate at apex.

*Measurements in millimeters.*—Length 8.0 to 13.5; width 3.9 to 6.7.

*Female genitalia* (fig. 52, *a*, *b*, *c*).—Genital tube tubular; apical plates rather thin, long, broad, flaring outward, the apical margins toothed or irregular; coxites large, laterally compressed, very heavily chitinized, especially near the apex; styli small, borne upon the dorsal bases of the coxites and invisible from above or below. Eighth sternite usually smoothly rounded at apex, but sometimes with a vague rounded emargination.

*Male genitalia* (fig. 52, *d*, *e*).—Median lobe not very heavily chitinized, brown; in profile moderately curved, apex very slightly recurved; deeply excavated dorsally, distal to the median orifice;

outline as seen from above smoothly rounded, apex obtusely rounded.

*Type locality*.—The flat, semidesert land below Grapevine Canyon, on the inland route between Los Angeles and Bakersfield, Calif., near Rose Station. [The type specimens are labeled "Bakersfield, Cal. IV-1934."]

*Types*.—Holotype female, allotype male, and one paratype, U.S.N.M. No. 56768; seven paratypes in my collection [now in collection L. J. Bottimer]; one female paratype each, both labeled "Cal." only, in the collections of the University of Ohio and H. C. Fall.

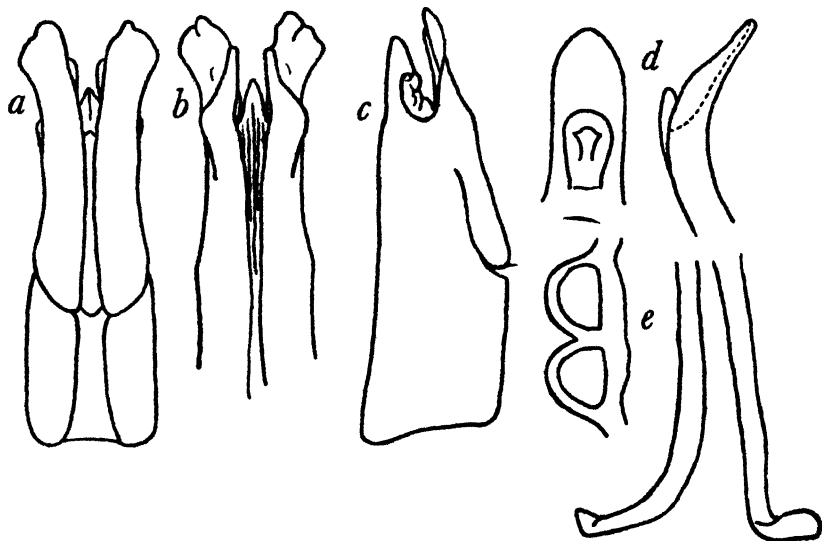


FIGURE 52.—*Eupagoderes griseus*, new species: *a*, Female genital tube, dorsal view; *b*, female genital tube, ventral view; *c*, female genital tube, lateral view; *d*, median lobe of male genitalia, dorsal and lateral views; *e*, accessory parts of male genitalia.

The specimens labeled "Bakersfield, Cal." were collected beneath dried cow dung in April.

Two large males in the collection of the United States National Museum, one from Kern County, Calif. (Hubbard and Schwarz), the other from Colton, Calif., and two similar males in the collection of H. C. Fall, have been tentatively referred to this species.

*Remarks*.—*Eupagoderes griseus* resembles closely *E. geminatus* Horn. Although when series of the two species are placed side by side they appear very different, an attempt to discover just what the differences are reveals so much variation that all the characters are eliminated except the female genitalia, the median sulcus of the rostrum, and the truncation of the hind tibiae. The truncation of the hind tibiae in *griseus* is usually broader and more transverse, lacking the raised inner edge found so frequently in *E. geminatus*. The latter character is, however, subject to some variation.

## EUPAGODERES AENEUS, new species

FIGURE 53

Robust, convex, dorsum slightly flattened; light brown, feebly and irregularly mottled with gray-brown and white, and more or less irrorate with black; scales iridescent, the iridescence predominantly red. Head and rostrum separated by a well-marked transverse impression. Rostrum well arched above, very slightly constricted at base beneath, in the female about as stout as that of *E. geminatus* Horn, in the male a little less stout; median sulcus faint or lacking; lateral sulci nearly obsolete, sharply converging at base of rostrum. Front very slightly flattened; remainder of head evenly, smoothly rounded; head and rostrum finely and sparsely punctate. Pronotum finely, sparsely punctate, feebly sulcate, from a little over one-fifth to slightly less than two-fifths wider than long, widest slightly behind the middle, posterior margin straight, anterior margin slightly pro-

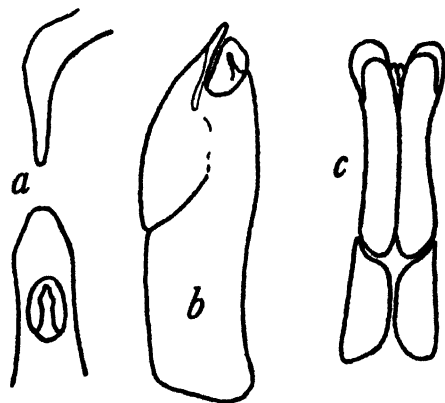


FIGURE 53.—*Eupagoderes aeneus*, new species: a, Median lobe of male genitalia, lateral and dorsal views; b, female genital tube, lateral view; c, female genital tube, dorsal view.

duced at center, sides broadly rounded, smooth. Elytra about one-fifth longer than wide, widest at or slightly behind the middle; striae fine, stria punctures very fine, intervals subequal in width and nearly or quite flat; elytral setae subdecumbent, tawny, moderately conspicuous. Legs fairly stout; tibiae not denticulate within, posterior tibiae obliquely truncate; tarsi with the third joint widest in the male, and with tufts of pubescence in both sexes.

*Measurements in millimeters.*—Length 7 to 10.1; width 3.5 to 5.2.

*Female genitalia* (fig. 53 b, c).—Genital tube tubular, rather heavily chitinized, very close to *E. geminatus* Horn in shape. Apical plates large, flat or slightly concave beneath; as viewed from above broadly rounded, with a transparent border. Coxites large, hairy; styli fairly large, placed upon the dorsolateral surface of the coxites. Eighth sternite broadly, smoothly rounded at apex.

*Male genitalia* (fig. 53, *a*).—Median lobe heavily chitinized, sharply curved, heavy at base, not deeply excavated above near the apex; median orifice broadly oval.

*Type locality*.—Virgin River, Utah.

*Types*.—Holotype female, allotype male, and four paratypes, U.S.N.M. No. 56769. The male allotype and one male paratype are labeled "U. T."; the three paratypes (one male and two females) are from Virgin River, Utah. A female specimen that may be considered a paratype is in the collection of the Academy of Natural Sciences of Philadelphia.

*Remarks*.—In only one of the seven specimens studied is the median sulcus of the rostrum present, and in one specimen the lateral sulci also are absent. In one specimen the front bears a trace of a median carina. This species may be distinguished from its nearest relatives by characters of the genitalia, the absence of rostral sulci, and the color.

EUPAGODERES MORTIVALLIS Fall

FIGURE 54

*Eupagoderes mortivallis* FALL, 1910, p. 192.

Robust, inflated, silvery white, usually more or less irrorate with plumbeous; a median and two lateral vittae on the pronotum plumbeous; middle of pronotal disk and sutural interval fulvous or lemon-yellow. Rostrum only moderately stout, sharply arched near apex above, not or hardly constricted at base beneath; median sulcus very fine, nearly obsolete in some specimens; lateral sulci short, shallow, diverging apically. Transverse impression between head and rostrum present, but usually feeble. Head rounded, front slightly flattened, very finely, sparsely punctate; rostrum more coarsely and closely punctate. Pronotum wider than long, widest at middle; apex slightly constricted; disk finely, sparsely punctate, median sulcus nearly or quite lacking. Elytra from about one-third longer than wide to a little less than twice as long as wide, widest at about the apical one-third, truncate at base; elytral striae finely impressed, punctures fine; intervals subequal in width except the first (sutural), which is narrow and convex. Legs moderately robust, tibiae finely denticulate within; posterior tibiae obliquely truncate.

*Measurements in millimeters*.—Length 12 to 18.

*Female genitalia* (fig. 54, *a*, *b*, *c*).—Genital tube heavily chitinized, tubular; apical plates moderate in size, curved downward and slightly concave beneath; coxites large, fleshy in appearance; styli moderate in size, set upon the dorsal face of the coxites halfway between base and apex. Eighth sternite broadly rounded and very broadly, shallowly emarginate at apex.

*Male genitalia* (fig. 54, *d*).—Median lobe about as in *E. geminatus* Horn, but much larger and with the apical margins more evenly arcuate (not sinuate).

*Type locality*.—Death Valley, Calif.

The U. S. National Museum collection contains several specimens from Death Valley, Calif.; also, one which appears at first glance to be an abnormal specimen of *E. desertus* Horn, from which it differs externally in the impressed elytral striae, the more impunctate, smoother appearance, and the fulvous suture. It is dark grayish yellow, with conspicuous irregularly placed ocellate spots of deep brown along the striae.



FIGURE 54.—*Eupagoderes mortivallis* Fall: *a*, Female genital tube, dorsal view; *b*, female genital tube, ventral view; *c*, female genital tube, lateral view; *d*, median lobe of male genitalia, dorsal and lateral views.

*Remarks*.—The female genitalia of *E. mortivallis* differ from those of *E. desertus* chiefly in the apical plates, which are nearly horizontal from side to side and concave beneath, not tilted upward at their lateral edges and nearly flat, and in the coxites' being more rounded as viewed from the side. The male median lobe is thinner, sharper at apex, and not squarely truncate as in *desertus*. *E. mortivallis* is more closely related to *E. geminatus* Horn, from which it may be distinguished by its size and color.

**EUPAGODERES MORTIVALLIS Fall, APPROXIMATUS, new variety**

Form as in *E. mortivallis* Fall. Color gray, irrorate with plumbeous scales; elytral intervals 2, 4, and 6 darker; no trace of fulvous or yellow except for a very narrow line along the elytral suture. Median sulcus of rostrum extremely fine. Pronotum more coarsely and closely punctate than in typical *E. mortivallis*. Genitalia as in *E. mortivallis*.

*Type locality*.—Baker, Calif., April (R. E. Barrett).

*Types*.—Holotype female and allotype male, Baker, Calif., U.S.N.M. No. 56770. One paratype female, Needles, Calif., in my collection [now in collection of L. J. Bottimer]. One paratype in the collection of H. C. Fall.

*Remarks*.—With this variety is tentatively included a specimen from Death Valley, Calif., which is uniform gray, the suture narrowly fulvous, the striae of a blackish tinge, and the head and pronotum yellow-gray.

This is merely a color form of *E. mortivallis* Fall, but it differs so markedly in appearance and color from that species that it has caused some confusion, and for that reason it has been thought well to give it a name.

## II. ROBUSTUS group

Included at present is a single species:

### EUPAGODERES ROBUSTUS, new species

#### FIGURE 55

Form robust, elytra greatly inflated; color uniform gray-white; scales feebly imbricated on elytra. Rostrum stout, moderately arched dorsally; median sulcus lacking; lateral sulci short, rather shallow, arcuate, convergent at base of rostrum. Head evenly rounded; head and rostrum moderately finely, evenly punctate, a short white seta in each puncture. Pronotum one-seventh wider than long, widest at apical two-fifths, base one-fifth wider than apex, sides evenly rounded; disk moderately coarsely, rather closely punctate, the median groove rather fine. Elytra inflated, together almost one-third longer than wide, widest at basal one-third; humeri not developed, but elytra truncate and swelling abruptly from base, wider at base than the base of the pronotum; stria punctures very coarse, round, deep, and not confluent; intervals 2, 4, and 6 very slightly wider, flat; intervals 3, 5, and 7 elevated; setae extremely minute, not or hardly visible at a magnification of about 30 diameters. Legs only moderately stout, tibiae not apparently denticulate.

*Measurements in millimeters*.—Length 9.5 to 12.4.

*Female genitalia* (fig. 55, *a*, *b*, *c*).—Genital tube lightly chitinated, subconical, apical plate lacking, coxites and styli extremely minute. Eighth sternite of *decipiens* type, acute, apex truncate or slightly emarginate, and hairy.

*Male genitalia* (fig. 55, *d*).—Median lobe heavily chitinated, moderately curved and thick at apex as viewed from the side; from above short and rather broad, very slightly dilated at apical one-third, apex broadly, evenly rounded, not deeply excavated above.

*Type locality*.—"20 mi. west of Yuma, Calif. X-27-24."

*Types*.—Holotype female, allotype male, and paratype female, the



two latter from Palmer, Ariz. (Hubbard and Schwarz), U.S.N.M. No. 56771.

*Remarks.*—The female paratype has a median carina upon the rostrum instead of a sulcus, terminating at the transverse impression. The frons is slightly produced, but not carinate. This specimen has become blackened and the setae show more plainly against the blackish background; also, the elytra are more inflated than in the other two specimens (one-fifth longer than wide), the abrupt widening from the base much more evident, almost enough to be considered humeri.



FIGURE 55.—*Eupagoderes robustus*, new species: *a*, Female genital tube, ventral view; *b*, female genital tube, dorsal view; *c*, female genital tube, lateral view; *d*, median lobe of male genitalia, dorsal and lateral views.

### III. DECIPIENS group

This group is characterized by the structure of the female genital tube, which is semimembranous with supporting rods of chitin, and bears large styli; by the acutely pointed eighth sternite of the female; and by the thick, rounded, deeply excavated median lobe of the male. The genitalia of the United States species are not distinguishable one from another, and for this reason only the genitalia of *E. decipiens* have been drawn. All the species in the *decipiens* group seem to be very closely related, and most of them vary so much that detailed descriptions would necessarily consist mainly of repetition and exceptions. The diagnostic characters in the key below must be used with caution.

#### KEY TO SPECIES OF DECIPIENS GROUP

1. Rostrum continuous with the front..... 2  
Rostrum separated from the front by a transverse impression..... 3
2. Brown or gray, less inflated, elytral striae distinct.....*decipiens* (LeConte)  
White, sometimes sparingly irrorate with plumbeous; elytral striae fine and indistinct..... *decipiens* (LeConte), variety *dunnianus* Casey
3. Setae conspicuous, semierect; median sulcus of rostrum extended onto front.....  
*pilosus*, new species  
Setae small, more nearly flat; median sulcus of rostrum not extended onto front..... 4
4. Vertex flattened, finely carinate in the type; scales pinkish cinereous; feebly mottled with gray.....*aridus* Fall

- Vertex evenly convex; scales whitish to cinereous; marmorate with darker gray----- 5
5. Median sulcus of rostrum shallow and vague----- *varius* (LeConte)  
 Median sulcus fine and sharp (in the type).  
*varius* (LeConte), variety *plumbeus* Horn

## EUPAGODERES DECIPIENS (LeConte)

## FIGURE 56

*Ophryastes decipiens* LECONTE, 1853, p. 445.

In this species there is a great deal of variation in size, shape, and degree of maculation. Some specimens are robust, convex, the body dilated and widest behind the middle, others are flatter and more parallel, with the body widest at about the middle. The color varies from almost uniform gray with blotches of white upon the elytra, through gray distinctly marked with brown and white, to a nearly uniform muddy brown. One median and two lateral vittae of darker color upon the pronotum are sometimes faint, but seem always to be present. The median sulcus of the rostrum is usually, but not always, represented by an obsolete fovea about opposite the antennal insertion. At times a median sulcus may be faintly suggested by a fine impressed line extending backward from the fovea. The lateral sulci

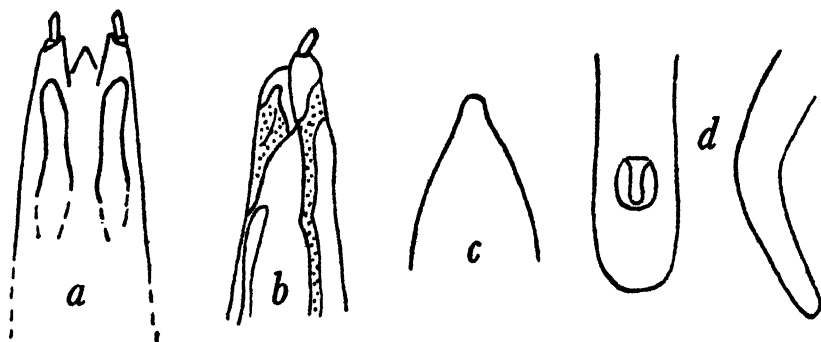


FIGURE 56.—*Eupagoderes decipiens* (LeConte): *a*, Female genital tube, dorsal view; *b*, female genital tube, lateral view; *c*, eighth sternite, female; *d*, median lobe of male genitalia, dorsal and lateral views.

are variable, sometimes nearly obsolete but usually well defined. The ridges between the sulci vary from obsolete to high and sharp. In the latter case their sudden rise at the base of the rostrum gives the profile the appearance of having a slight transverse impression between head and rostrum. The ridges above and in front of the eyes are pronounced. The punctation of the pronotum varies from coarse and rather close to practically absent. As a rule it is fairly coarse and moderately close, coarser and closer at the sides. The elytral striae are fine but distinct, and the tawny, moderately conspic-

uous setae are arranged in rows upon the flat elytral intervals. Posterior tibiae truncate at apices.

*Measurements in millimeters.*—Length 6.1 to 11.3, averaging about 8.1.

*Female genitalia* (fig. 56, *a*, *b*, *c*).—Genital tube tubular, membranous, with supporting rods, or baculi. These consist of a rod at each side ventrally and another on each side dorsally. The latter two are interrupted, the apical portion of each broadening out as a chitinous plate on each side near the apex of the tube. Coxites large, fleshy; styli large, chitinous, with long setae. Eighth sternite acutely angulate, the apex truncate or narrowly rounded, and hairy.

*Male genitalia* (fig. 56, *d*).—Heavily chitinized; as seen in profile very thick, abruptly curved at about basal two-fifths, base and apex nearly straight. As viewed from above, sides nearly parallel, apex very broadly and evenly rounded, deeply excavated below the median orifice.

*Type locality.*—"Eagle Pass" [Texas].

Specimens of *Eupagoderes decipiens* have been seen from the following localities: ARIZONA, Cat Pass, Tucson Mountains (W. D. Pierce); Tucson (Hubbard and Schwarz; Wickham); Catalina Springs (Hubbard and Schwarz); Colorado Canyon (Barber and Schwarz); Indian Garden, Grand Canyon (Wickham); Catalina Mountains (C. Voorhies); Sabine Canyon. NEW MEXICO, Mesilla Park (C. N. Ainslie; Cockerell); Alamogordo. TEXAS, Cotulla (W. D. Pierce; J. C. Crawford); Del Rio (Wickham); El Paso (Wickham; W. Knaus); Sander-son (J. D. Mitchell); Brewster County; Mission (B. R. Coad); Val Verde County; Devils River; Laredo (E. A. Schwarz); Chisos Mountains; "between Pecos River and Guadalupe Mts." (F. L. Odenbach). MEXICO, Monterrey (E. A. Schwarz); Monclova (E. A. Schwarz).

**EUPAGODERES DECIPIENS (LeConte), variety DUNNIANUS Casey**

*Eupagoderes dunnianus* CASEY, 1888, p. 240.

This name seems to have caused considerable confusion. Casey's description of the species states that it is white, with the striae extremely fine, finely and remotely punctate. The description fits the type very well, but some specimens included in the Casey collection series are the usual brown specimens of *decipiens* with the striae slightly less well marked than usual. I have found no characters other than those given above that distinguish *dunnianus* from *decipiens*. The genitalia are the same. Although this is merely an extreme form of *decipiens*, I believe the name should be retained, as specimens occasionally come to hand that are very robust, white, and with subobsolete striae, and these are otherwise difficult to place.

*Type locality.*—El Paso, Tex.

EUPAGODERES PILOSUS, *ms*

Of about the same size and shape as the more common specimens of *E. decipiens* (LeConte), perhaps a trifle more robust. Color dark gray, sparingly and irregularly mottled with black, especially upon the basal portions of the second and fourth elytral intervals; pronotum bearing a blackish lateral stripe upon each side and a narrow black median line. Head moderately, evenly convex, a broad depression separating it from the rostrum, the dorsal curve of which, if carried through, would just about meet the upper margin of the eye; rostrum stout, markedly arched toward apex, trisulcate, the median sulcus shallow and rather vague and extending onto the front nearly to the vertex; lateral sulci deep, converging toward the base of the rostrum; frons and rostrum moderately thickly set with fine, semierect setae. Pronotum about one-fourth wider than long, widest at middle, sides smoothly and evenly rounded; anterior and posterior margins nearly straight; disk with a deep median groove and coarsely, closely punctate, bearing numerous small semierect setae. Elytra together one-fifth longer than wide, three-fifths longer than the pronotum; striae very fine, the punctures fine and shallow; elytra closely set with rather long, dark brown or black, semierect setae. Legs moderately stout.

*Measurements in millimeters.*—Length 7.5 to 8.1.

*Type locality.*—Canyon City, Colo.

*Types.*—Holotype female and one female paratype collected at type locality, H. Soltan collection 9-V-97, U. S. N. M. No. 56772.

*Remarks.*—The genitalia of this species places it in the *decipiens* group, from the other members of which it may be distinguished by the conspicuous semierect setae, the more widely imbricate scales of the elytra, and the sulcate frons.

## EUPAGODERES VARIUS (LeConte)

*Ophryastes varius* LeConte, 1853, p. 444.

This species is the most variable of the genus in size, shape, and color; therefore a detailed description is not practicable. Some specimens resemble *E. decipiens* rather closely in general appearance although they are nearly always lighter in color. The form of the body and the sculpture are subject to the same amount of variation as in that species. The average size is larger, but some specimens are very small.

*Measurements in millimeters.*—Length 7.8 to 12.8, averaging about 9.5.

*Type locality.*—Desert of the Colorado, Calif.

Specimens have been examined from the following localities: CALIFORNIA, Palm Springs (Hubbard and Schwarz); Palm Canyon (R. E. Campbell); Mountain Springs, San Diego County (W. D.

Pierce); Holtville (W. Benedict); San Diego County (Coquillett); Imperial County (J. C. Bridwell); Goffs, Cabazon (E. D. Ball); San Bernardino County; Indio (Wickham); Death Valley; Saltdale (A. C. Davis); Boundary Canyon, Amargosa Mountains, Inyo County. ARIZONA, Littlefield (E. W. Davis); Fort Yuma (Hubbard and Schwarz). NEVADA, Lee Canyon, Spring Mountain; Hawthorne; Las Vegas (David E. Fox). UTAH, St. George; Virgin River.

*Remarks.*—Occasional specimens are extremely difficult to distinguish from *E. aridus* Fall, which appears to be the most closely related species. The characters given in the key will serve to separate *E. varius* from others of the group.

**EUPAGODERES VARIUS (LeConte), variety PLUMBEUS Horn**

*Eupagoderes plumbeus* HORN, 1876, p. 35.

According to Fall (1910, p. 193) this species is the same as *E. varius* (LeConte). In the type specimen of *E. plumbeus*, however, the median sulcus of the rostrum is fine, but sharply defined, whereas I have not seen *E. varius* with more than a bare indication of the median sulcus. The paratypes in the Horn collection seem to be a mixed lot and may not all represent this variety. One of them has the median sulcus almost lacking. A specimen of *E. aeneus* Davis is also included in the series. *E. plumbeus* Horn is certainly very closely related to *E. varius* (LeConte), but on the basis of the difference given above it seems best to retain the name for the present. No comparison of the genitalia has been made but it seems likely that these would turn out to be indistinguishable from those of the rest of the group.

*Type locality.*—Owens Valley, Calif.

**EUPAGODERES ARIDUS Fall**

*Eupagoderes aridus* FALL, 1910, p. 192.

All species of the *decipiens* group are closely related, but the relationship between *E. varius* (LeConte), and *E. aridus* Fall seems to be unusually close. Separation of the two depends largely upon color and general appearance. The carinate front occurs in both species, but much less frequently in *aridus*. In fact, the type is the only specimen of *aridus* known to me in which this character is found. I have before me a large, pink, subvittate specimen which answers to the description of *aridus* perfectly except that the front is not carinate, but, this character being so far unique to the type, the specimen is relegated to the *aridus* series. Another specimen, smaller in size, gray with irregular brown mottling, would be unhesitatingly placed with *varius* except that the frons is distinctly carinate. *E. aridus* in general tends to be vittate, intervals 3, 5, and 7 being colored with black or plumbeous, the other intervals more irregularly marked with

gray. This species also tends to be less parallel in form than *E. varius*. The average size is somewhat larger than in *varius*.

*Measurements in millimeters*.—Length 8.6 to 12.3, averaging about 10.5

*Type locality*.—Western border of the Colorado Desert, Calif.

I have the following records of capture for this species: CALIFORNIA, Imperial County (J. C. Bridwell); San Diego County; Holtville (A. C. Davis). ARIZONA, Palmer (Hubbard and Schwarz).

#### IV. SPECIOSUS group

This group is characterized by the female genital tube being dorso-ventrally flattened, robust, and more or less wedge-shaped as viewed from above or below. The transverse impression between the head and rostrum seems to be rather an unstable character in this group

#### KEY TO SPECIES OF SPECIOSUS GROUP

1. Rostrum continuous with the front..... 2  
Rostrum separated from the front by a transverse impression..... 6
2. Disk of pronotum finely and sparsely punctate..... 3  
Disk of pronotum more coarsely and closely punctate..... 4
3. Color chocolate brown, pronotum and elytra vittate with white.  
speciosus (LeConte)  
Color white, not or but feebly mottled.....nivosus Fall
4. Larger (10 to 17 mm.); scales predominantly white; fore tibiae denticulate...5  
Smaller (6 to 10.6 mm.); scales predominantly gray or brown; fore tibiae  
not denticulate.....sordidus (LeConte)
5. White, not or but feebly mottled.....nivosus Fall  
White, heavily mottled with ocellate plumbeous spots...marmoratus Fall
6. Gray, even numbered elytral intervals more or less strongly marked with  
black or darker gray; setae small, but visible; Texas.  
simulans Van Dyke  
Gray, usually strongly, irregularly blotched with black; setae extremely  
small and inconspicuous; California, Arizona, Nevada, and Utah.  
argentatus (LeConte)

#### EUPAGODERES SPECIOSUS (LeConte)

#### FIGURE 57

*Ophryastes speciosus* LECONTE, 1853, p. 444.

Elongate, moderately convex, deep chocolate brown with two blotchy white vittae upon the pronotum and irregular white vittae upon the even numbered elytral intervals; head with an irregular sprinkling of white scales. Rostrum long, stout, continuous with the front, trisulcate, the median sulcus narrow and deep. The ridges between the sulci are greatly developed and are flat dorsally, giving the deep lateral sulci the appearance of being upon the sides of the rostrum and converging rather sharply toward the the base dorsally; setae of rostrum small, squamiform, recumbent. In some specimens the median sulcus extends up onto the front to about the level of the upper edge of the eyes. Pronotum usually widest before the middle,

finely and sparsely punctate and with a fine median impression. Elytral striae fine, punctures distinct; intervals nearly flat, 3 and 5 wider; setae fine, yellowish, placed in the stria punctures and in a fine secondary punctation upon the intervals. Legs only moderately stout, brown with a sprinkling of white scales; tibiae minutely denticulate on the inner side.

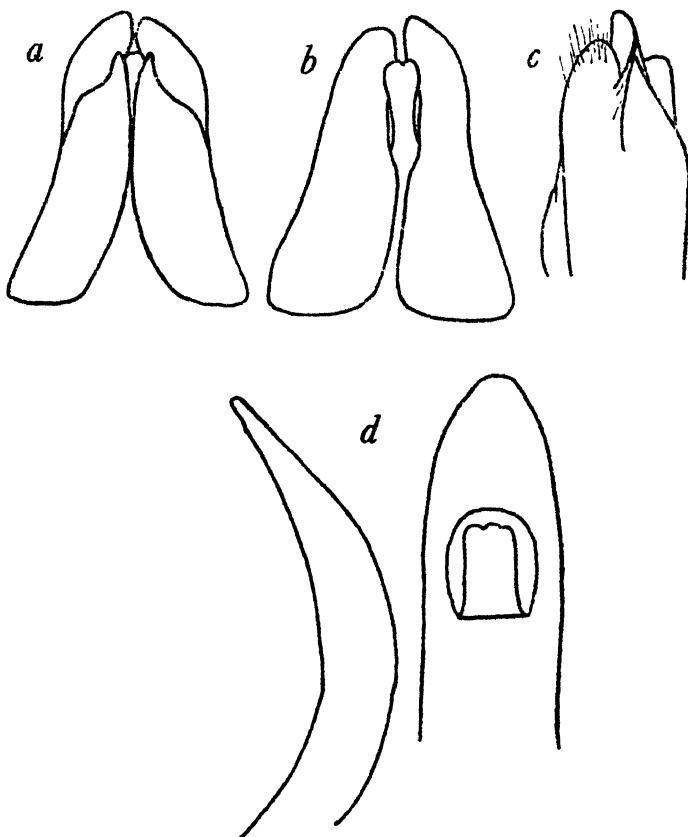


FIGURE 57.—*Eupagoderes speciosus* (LeConte): *a*, Female genital tube, dorsal view; *b*, female genital tube, ventral view; *c*, female genital tube, lateral view; *d*, median lobe of male genitalia, lateral and dorsal views.

*Measurements in millimeters.*—Length 14.4 to 21.5.

*Female genitalia* (fig. 57, *a*, *b*, *c*).—Genital tube wedge-shaped, dorsoventrally flattened, rather heavily chitinized. Coxites large, hairy; styli very small; apical plates large, their upper surfaces slightly concave.

*Male genitalia* (fig. 57, *d*).—Median lobe heavily chitinized, moderately, evenly curved in profile, apex thin. As viewed from above, sides parallel or nearly so, the apex evenly, acutely rounded; not deeply excavated below the median orifice; median orifice large, oval, truncated basally.

*Type locality*.—"Eagle Pass" [Texas].

I have seen specimens of this species from Alpine, Tex., and from San Luis Potosí, Chihuahua City, and Saltillo, Coahuila, Mexico.

*Remarks*.—*Eupagoderes speciosus* (LeConte) is evidently a Mexican species for which the southern United States is the northern limit of distribution. Its large size, dark color, extremely lightly punctate pronotum, and conspicuous white vittae make this species the most easily recognized of the genus.

**EUPAGODERES NIVOSUS Fall**

*Eupagoderes nivosus* FALL, 1910, p. 190.

Elongate, moderately convex, covered with white scales throughout, sometimes with irregularly scattered small black spots; a median and two vague lateral gray vittae sometimes present upon the pronotum. One specimen seen was lightly irrorate with black upon the basal half of the elytra. Rostrum long, not greatly arched above, not constricted at base beneath; continuous with the front, trisulcate, the median sulcus sharply defined and extending up onto the front in some specimens; lateral sulci deep, broadly arcuate, slightly convergent basally. Head smoothly rounded, head and rostrum finely and sparsely punctate. Pronotum one-third to two-sevenths wider than long, sides evenly, strongly arcuate, apical margin slightly produced at middle, basal margin slightly emarginate at middle; median groove present; disk moderately finely and rather irregularly punctate, having a rugose appearance which is more noticeable toward the sides; sides of pronotum subtuberculate in some specimens. Elytra oval, striae finely impressed, striae punctures fine; intervals feebly convex, 3 and 5 slightly wider. Legs moderately robust; all tibiae denticulate within; posterior tibiae truncate, the flattened end narrow and scaly.

*Measurements in millimeters*.—Length 11 to 15.

*Female genitalia*.—Genital tube short, wedge shaped, dorsoventrally flattened, rather lightly chitinated; apical plates thick, concave above, their apices directed upward; styli extremely small, borne upon membranous areas on the dorsal bases of the apical plates. Eighth sternite broadly, obtusely emarginate at apex.

*Male genitalia*.—Median lobe only moderately heavily chitinated, brown, curved less sharply in profile than in most species, apex very slightly recurved; moderately deeply excavated apically as viewed from above, apex broadly rounded, sides near the apex sinuate, sides posterior to the median orifice straight, slightly divergent.

*Type locality*.—Phoenix, Ariz.

Specimens of this species have been seen from Phoenix (J. S. Tait) and Rice (D. K. Duncan), Ariz.



## EUPAGODERES MARMORATUS Fall

FIGURE 58

*Eupagoderes marmoratus* FALL, 1910, p. 191.

This species is very closely related to *E. nivosus* Fall, and resembles it closely in shape. It is distinguished chiefly by being strongly mottled with ocellate black spots, especially along the elytral striae, by having the rostrum usually more deeply sulcate, and the pronotum more coarsely and closely punctate. In some specimens the median sulcus of the rostrum continues up onto the front nearly to the vertex, in which case it is usually in the center of a median brown stripe. The lateral sulci may be evenly arcuate or straight apically, and are rather

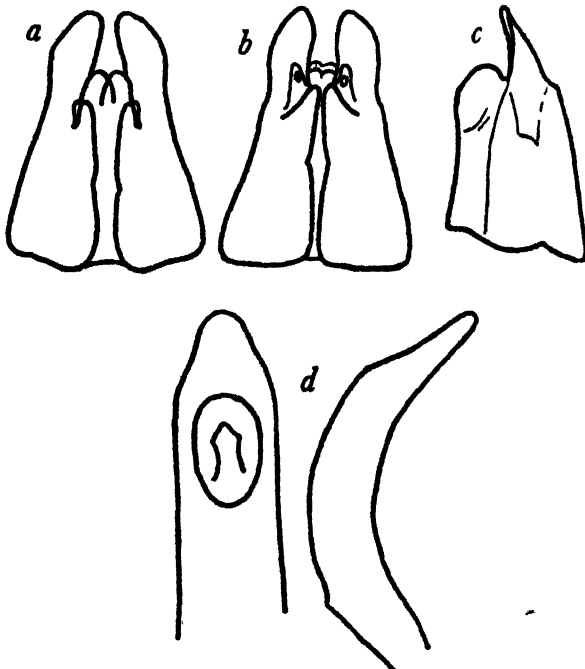


FIGURE 58.—*Eupagoderes marmoratus* Fall: *a*, Female genital tube, dorsal view; *b*, female genital tube, ventral view; *c*, female genital tube, lateral view (dorsal side to left); *d*, median lobe of male genitalia, dorsal and lateral views.

sharply convergent near the base of the rostrum. In many specimens the ridges between the sulci are so pronounced that the head and rostrum have separate convexities as viewed from the side, giving the illusion of a transverse impression between head and rostrum. The pronotum is usually a little more than one-fifth wider than long, and varies from moderately coarsely, sparsely punctate to coarsely and closely punctate. In most specimens the prothorax at the sides is so densely punctate that the punctures coalesce, and there are small but very evident tuberosities present. The spots upon the elytra are

very rarely lacking, and are ocellate with buff or tawny centers. In certain small specimens examined the elytra are unicolorous gray or white, nearly or quite lacking markings, the front of the head or rostrum or both strongly marked with black. The third tarsal joint in many specimens is no wider, perhaps a little narrower, than the second.

*Measurements in millimeters.*—Length 10 to 17, averaging about 14.

The genitalia of both sexes are identical with those of *E. nivosus* Fall. It is possible that this species represents a race or variety of *E. nivosus*.

*Type locality.*—Tucson, Ariz.

Specimens of *E. marmoratus* Fall have been seen from the following Arizona localities: Tucson (Wickham; J. W. Toumy; G. Hofer); Rice (D. K. Duncan); Florence (C. R. Biederman); Phoenix (J. S. Tait); Globe (D. K. Duncan); Wellington Well, Quitoota Mountains.

#### EUPAGODERES SORDIDUS (LeConte)

##### FIGURE 59

*Ophryastes sordidus* LeConte, 1853, p. 445.

Color usually some shade of gray, irregularly mottled with white and brown or dark gray, but three male specimens from Vaughn, N. Mex., in the United States National Museum collection are predominantly light brown mottled with gray and white. In the lighter-colored specimens there is a brown median line upon the front and a brown patch above each eye. The pronotum usually has a rather wide brown vitta at either side. Rostrum rather short, not very stout, trisulcate, the median sulcus sharply defined and ending abruptly at the junction of the head and rostrum, apically either extending to the apex of the rostrum or ending abruptly about opposite the antennal insertions; lateral sulci deep, nearly straight, usually slightly divergent at the base of the rostrum. Rostrum constricted at base beneath and usually not evenly continuous with the front above, as in most specimens the head and rostrum have slight separate convexities as viewed from the side. Punctuation of pronotum rather coarse, but sparse, coarser and closer at the sides. Elytral striae fine but usually distinct, in some specimens becoming obsolete in the center of the disk. The three lateral striae on each side usually consisting of rows of large, oblique punctures, the other striae impressed, the punctures connected. Legs rather thin, tibiae not denticulate within, posterior tibiae truncate, the truncation wide, glabrous, and usually slightly elevated. There seems to be very little sexual difference in the tarsi of this species.

*Measurements in millimeters.*—Length 6.2 to 10.6.

*Female genitalia* (fig. 59, *a, b, c, d*).—Genital tube stout and short; apical plates heavily chitinized, small, pointed, close to the midline,

and so twisted that their concave faces are ventrolateral, their apices divergent; coxites produced, chitinous, divergent at apex; styli very small, flattened, situated upon the dorsal face of the coxites. Eighth sternite broad, acutely emarginate at apex.

*Male genitalia* (fig. 59, *e*, *f*).—Median lobe small, very broadly rounded at apex and deeply excavated distad of the median orifice;



FIGURE 59.—*Eupagoderes sordidus* (LeConte): *a*, Female genital tube, dorsal view; *b*, female genital tube, ventral view; *c*, female genital tube, lateral view; *d*, eighth sternite of female; *e*, median lobe of male genitalia, dorsal view; *f*, median lobe of male genitalia, lateral view.

median orifice slightly elongate, truncate at base; median lobe in profile rather thin, evenly curved.

*Type locality*.—Platte River.

Specimens of this species have been examined from the following localities: ARIZONA, Winslow (Hubbard and Schwarz; Wickham). NEW MEXICO, Tucumcari (Wickham); Fort Wingate; Albuquerque (Wickham); Deming (Wickham); Santa Fe; Corona; Vaughn; San Juan Valley, Taos County; Roswell; Magdalena (Strickler). TEXAS, Marfa; Marathon; Chisos Mountains, Brewster County. KANSAS, "W. Kansas" (Popenoe).

#### EUPAGODERES SIMULANS Van Dyke

##### FIGURE 60

*Eupagoderes simulans* VAN DYKE, 1934, p. 176.

Moderately robust, convex, covered with dark gray scales, with irregular mottlings of black or dark gray upon the elytra and three dark vittae upon the pronotum. Rostrum moderately stout, deeply transversely grooved at base beneath, moderately arched at apex above, separated from the front by a well-marked transverse impression; median sulcus sharply defined; lateral sulci broad and deep, nearly straight, converging toward the base of the rostrum. Front slightly flattened, head otherwise evenly rounded. Pronotum almost

one-third wider than long, widest at about the middle, base straight, apex not appreciably advanced, sides evenly, feebly arcuate, appearing subparallel; disk with punctation coarse, irregular, usually giving a rugose appearance; median impression sometimes deep, sometimes subobsolete and interrupted. Elytra together about one-third longer than wide, widest at or slightly behind the middle; striae finely impressed, the second markedly deeper; strial punctures large and shallow; intervals moderately convex, even numbered ones usually somewhat narrower and darker in color; setae small, white, rather numerous. Legs moderately robust, fore tibiae not greatly curved, finely denticulate in some males, not so plainly so in females; posterior tibiae not truncate at apex, obliquely rounded on outer side.

*Measurements in millimeters.*—Length 9.1 to 12.0.

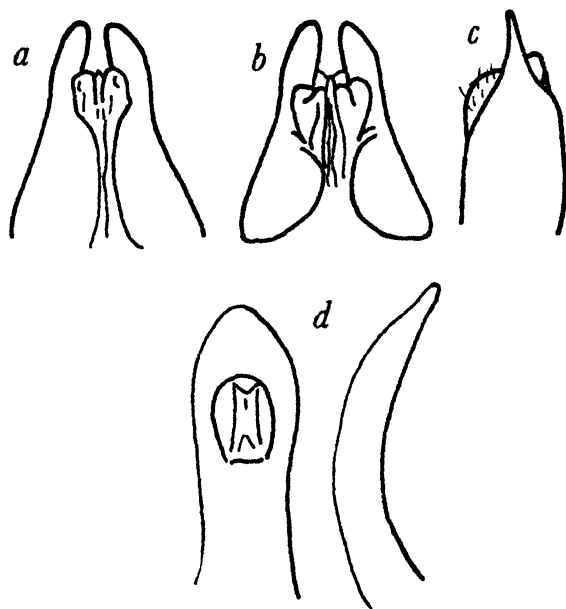


FIGURE 60.—*Eupagoderes simulans* Van Dyke: *a*, Female genital tube, dorsal view; *b*, female genital tube, ventral view; *c*, female genital tube, lateral view; *d*, median lobe of male genitalia, dorsal and lateral views.

*Female genitalia* (fig. 60, *a*, *b*, *c*).—Very similar to those of *E. argentatus* (LeConte), but smaller, and with the apical plates usually slightly more rounded and a trifle more concave.

*Male genitalia* (fig. 60, *d*).—Median lobe thick, evenly curved, narrowed a little at apex as viewed from the side; as viewed from above, apex inflated, moderately deeply excavated.

*Type locality.*—Allamore, Tex.

I have seen specimens from Allamore and from Chisos Mountains

Tex., all collected in July. In one of the latter specimens the ridges between the rostral sulci are so greatly developed that the transverse impression between the head and rostrum is completely wanting. This species superficially resembles *E. geminatus* Horn, as pointed out by Van Dyke, 1934, p. 177, but may be distinguished from that species by the stouter rostrum, and the genitalia, as well as by the locality. I do not think the character of the rounded or truncate posterior tibiae will serve to separate the two, as *E. geminatus* exhibits too much variation in this respect. From *E. argentatus* (LeConte), to which it seems most closely related, *simulans* may be distinguished by the smaller size, the small but plainly visible setae of the elytra, the less acutely arched apex of the rostrum, the well-defined elytral striae, and the color pattern.

EUPAGODERES ARGENTATUS (LeConte)

FIGURE 61

*Ophryastes argentatus* LeConte, 1853, p. 444.

Robust, inflated, color varying from pearly gray (with intervals 2, 4, and 6 brownish) to almost uniform black. The usual specimens are whitish or gray, strongly and irregularly marked with black. The form and convexity vary, but in general the sides of the body diverge rather regularly back from the thorax, and the body is widest at about the apical one-third. Rostrum strongly arched above, very stout, not constricted at base beneath, widened apically; trisulcate, the median sulcus moderately deep, sharply defined, sometimes extended onto the front for a short distance; lateral sulci subparallel, curved, convergent basally. Median impression between head and rostrum usually very well marked. Pronotum four-fifths to five-sevenths wider than long, widest at apical one-fifth, coarsely and moderately closely punctate. Elytral striae consisting of rows of large, round, deep disconnected punctures; intervals nearly flat; setae very minute, white. Legs fairly robust, anterior tibiae denticulate within, posterior tibiae subtruncate or rounded at apex.

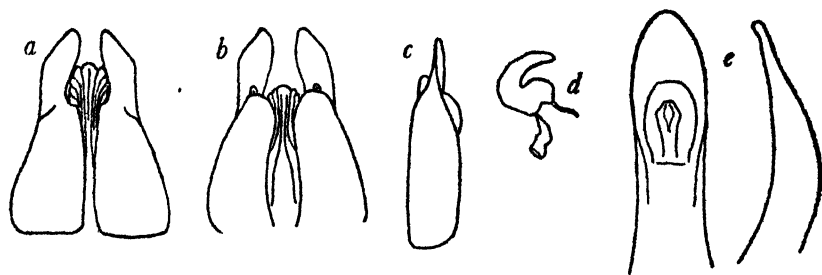


FIGURE 61.—*Eupagoderes argentatus* (LeConte): *a*, Female genital tube, dorsal view; *b*, female genital tube, ventral view; *c*, female genital tube, lateral view; *d*, receptaculum seminis; *e*, median lobe of male genitalia, dorsal and lateral views.

*Measurements in millimeters.*—Length 9.5 to 15.8.

*Female genitalia* (fig. 61, *a, b, c, d*).—Genital tube short, lightly chitinated, almost as wide at base as long; sides converging apically as viewed from above or below, parallel as viewed from the side. Apical plates large, thin, acutely rounded at apex, concave dorsally; coxites large, semimembranous; styli extremely minute, borne upon a small membranous area on the bases of the apical plates as in *E. marmoratus* Fall.

*Male genitalia* (fig. 61, *e*).—Median lobe long, moderately heavily chitinated; in profile not much curved, bisinuate near the apex; as viewed from above very shallowly excavated dorsally, apex rounded, margins near apex very slightly sinuate.

*Type locality.*—"Vallecitas," Calif.

Specimens of *Eupagoderes argentatus* (LeConte) have been seen from the following localities: CALIFORNIA, Yuma (Wickham); Palm Canyon, Riverside County (W. Benedict); Holtville (A. C. Davis); Saltdale (A. C. Davis); Imperial County (J. C. Bridwell); La Riera Valley, San Diego County. ARIZONA, Yuma (Herbert Brown); Tucson; Florence (C. R. Biederman); Palmerlee (C. R. Biederman). NEVADA, Glendale (E. W. Davis). UTAH, St. George (Wickham); Virgin River.

#### V. LUCANUS group

This group is represented by only one species:

##### EUPAGODERES LUCANUS Horn

##### FIGURE 62

*Eupagoderes lucanus* HORN, 1876, p. 34.

Cinereous or brown, with irregular mottlings of black; pronotum with a diffuse median and two conspicuous, lateral black stripes (one each side) the latter continuing along the sides of the head. Scales imbricated throughout. Rostrum long, more parallel and less stout than in most species of the genus, only moderately arched near apex dorsally and not greatly dilated; trisulcate, median sulcus narrow, lateral sulci moderately deep, arcuate. Front markedly flattened. Transverse impression between head and rostrum vague, owing to this flattening of the front. Pronotum about one-third wider than long, widest slightly behind the middle; subglobular; strongly narrowed in front, base one-fifth wider than apex; broadly and evenly rounded at sides, anterior and posterior margins straight; disk very coarsely, closely punctate. Elytra from one-third to two-fifths longer than wide, widest before the middle; at base wider than the base of the pronotum.

Most specimens have well-developed humeri. Strial punctures coarse, distinct; elytral intervals convex, the third more convex and

wider than the second or fourth; setae minute, tawny. Legs moderately stout, all tibiae denticulate.

*Measurements in millimeters*.—Length 0.9 to 12.1.

*Female genitalia* (fig. 62, *a*, *b*, *d*).—Genital tube very lightly chitinized, laterally compressed; coxites large, angular, curved downward slightly at apex, with a rather wide rim of thick setae upon the dorsal edge; styli small, set upon the ventral face of the coxites. Eighth sternite produced into two large teeth, curving ventrally.

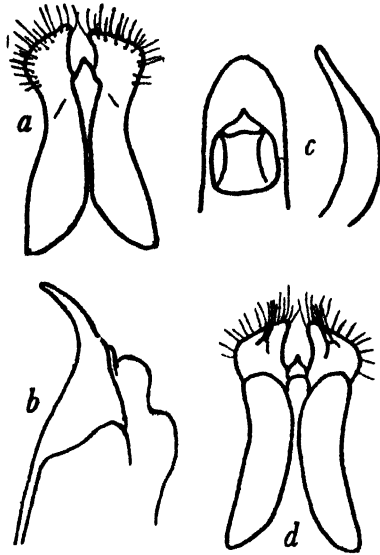


FIGURE 62.—*Eupagoderes lucanus* Horn: *a*, Apex of female genital tube, dorsal view; *b*, eighth sternite of female, lateral view; *c*, median lobe of male, dorsal and lateral views; *d*, female genital tube, ventral view.

*Male genitalia* (fig. 62, *c*).—Median lobe rather lightly chitinized, evenly and not greatly curved in profile, apex slightly recurved. From above, extremely short and broad, very slightly excavated at apex, median orifice large.

*Type locality*.—Cape San Lucas, Baja California.

This species seems to be confined to Baja California. I have seen specimens from Santa Rosa (Gus Boyer) and Cape San Lucas (Horn).

*Remarks*.—*Eupagoderes lucanus* Horn is set apart from all the others of the genus by the brown color, the elongate rostrum, the equal basal joints of the antennal funicle, and, above all, by the extraordinary development of the female eighth sternite into two large teeth, curving downward, a character that is as peculiar in *Eupagoderes* as is the female genitalic structure of *symmetricus* Fall in the genus *Ophryastes*.

One specimen examined has large subsidiary median sulci upon the rostrum, the base of the rostrum being 5-sulcate, and the

subsidiary sulci joining the median and causing it to be very broad apically. Nearly all the punctures of this species have a glabrous spot at the bottom.

I have not seen the following three species, but I have placed them in the key as best I could from the published descriptions.

**EUPAGODERES SETOSUS Van Dyke**

*Eupagoderes setosus* VAN DYKE, 1934, p. 179.

This species, as indicated in the key, runs close to *aeneus*, both having opalescent scaly vestiture. It differs from *aeneus* in the longer white setae, the convex front of the head, the color, and, if that character has weight, in the truncate hind tibiae. From *E. mortivallis* Fall, to which it runs in Fall's key, it differs in the conspicuous setae, the smaller size, and the color.

*Type locality*.—Phoenix, Ariz. [Recorded only from the type locality.]

**EUPAGODERES HUACHUCAE Van Dyke**

*Eupagoderes huachucae* VAN DYKE, 1934, p. 180.

In the key this species is placed near *E. marmoratus* Fall. From the description I judge it belongs in the *speciosus* group, close to *sordidus* (LeConte), to which it appears to be more closely related than to *E. mexicanus* Sharp, with which Van Dyke compares it. From *E. sordidus* (LeConte) it differs in the larger size and the finer punctuation of the pronotum.

*Type locality*.—Babocomari River, Huachuca Mountains, Ariz. [Recorded only from the type locality.]

**EUPAGODERES HALLI Van Dyke**

*Eupagoderes halli* VAN DYKE, 1934, p. 181.

Seems to differ from *E. sordidus* (LeConte) chiefly in the flattened front of the head. Examination of the genitalia of the above three species would possibly clear up their true relationships.

*Type locality*.—Nineteen miles southwest of Kayenta, Navajo County, Ariz., altitude 6,500 feet.

*Types*.—Also recorded (paratypes) from 23 miles west of Kayenta, Ariz., altitude 6,900 feet.

[No mention of *Eupagoderes cretaceus* Sharp (1891, p. 96) was found in Davis's manuscript. Champion (1911, p. 321) records *cretaceus* from Arizona, and suggests that it may be a synonym of *sordidus* (LeConte). Tanner (1939, p. 31) describes two new species of *Eupagoderes* from Utah which are not included in Davis's treatment of the genus. These are: *E. utahensis* Tanner, type locality St. George, Washington County, and *E. hardyi* Tanner, type locality north fork at Provo Canyon, Utah County, elevation 6,300 feet. Both species are placed by Tanner in the vicinity of *geminatus* Horn.]



Genus *AMYDROGMUS* Pierce

*Amydrogmus* PIERCE, 1913, p. 374. (Genotype, *A. variabilis* Pierce, monobasic and original designation.)

This genus is defined by Pierce as follows:

Rostrum with scrobes deep and definite, passing rapidly inferior; rostral striae almost obsolete, indicated by faint depressions; third tarsal joint broadly bilobed, and pubescent beneath; second abdominal segment subequal to the two following; prothorax not tuberculate at sides.

In view of the great variation in depth of the rostral sulci in the other genera of the Ophryastini, it seems to me that the most striking character of this genus is the thorax, which is wider at the apex than at the base, a feature that is more differentiating than the nearly obsolete rostral striae, and that is sufficient to distinguish *Amydrogmus* from other genera of the group.

*AMYDROGMUS VARIABILIS* Pierce

## FIGURE 63

*Amydrogmus variabilis* PIERCE, 1913, p. 374.

Pierce's original description is as follows:

Small, resembling *Sapotes puncticollis* in form, with elytra more or less robust, closely covered with pavement scales, which are generally white, but sometimes heavily mottled with brown, and with two brown fasciae [stripes] on prothorax. Length 4-6 mm.; width 1.75-2.75 mm. Beak strongly constricted at base above and beneath, a little longer than head above, densely covered with white polygonally crowded pavement scales, with short erect setae interspersed, apically emarginate and medially shallowly sulcate, also with feeble longitudinal impressions in front of eyes. Antennae densely clothed with scales, with exception of the club, which is finely pubescent. Prothorax a little shorter than head; truncate at base and apex; ocular lobes small, finely fimbriate; sides broadly arcuate, base not as wide as apex, slightly constricted in front of base; surface very unevenly punctate, with deep punctures of variable sizes; in specimens showing color, two fasciae [stripes] of brown scales; vestiture as described for beak. Elytra of females inflated as in *Tosastes ovalis* and *globularis*, while in males very little wider than the thorax; elytral striae very fine, punctures fine, interstitial punctures irregular but as large as stria punctures; surface sometimes mottled with brown. Undersides densely squamose and clothed as above. Last ventral segment in female elongate triangular, apically rounded, and longer than the two preceding segments. Legs densely squamose; corbels of posterior tibiae with a double row of spines, inclosing an elliptical squamose area.

*Female genitalia* (fig. 63, *a*, *b*, *d*).—Eighth sternite sharply acute, narrowly rounded at apex, apex slightly hairy. Genital tube rather lightly chitinized, laterally compressed; apical plates lacking; coxites large; styli large. Receptaculum seminis with cornu fairly thin, irregular, only slightly hooked; nodulus moderately large; ramus subglobular; ductus receptaculi thin, not curved downward.

*Male genitalia* (fig. 63, *c*).—Median lobe moderately heavily chitinized, thick, very slightly curved in profile, dorsal profile not

sinuate but evenly rounded to apex. From above elongate, widened near apex, which is acutely rounded; median orifice very elongate, flap long and thin.

*Type locality*.—Brewster County, Tex., on the Rio Grande.

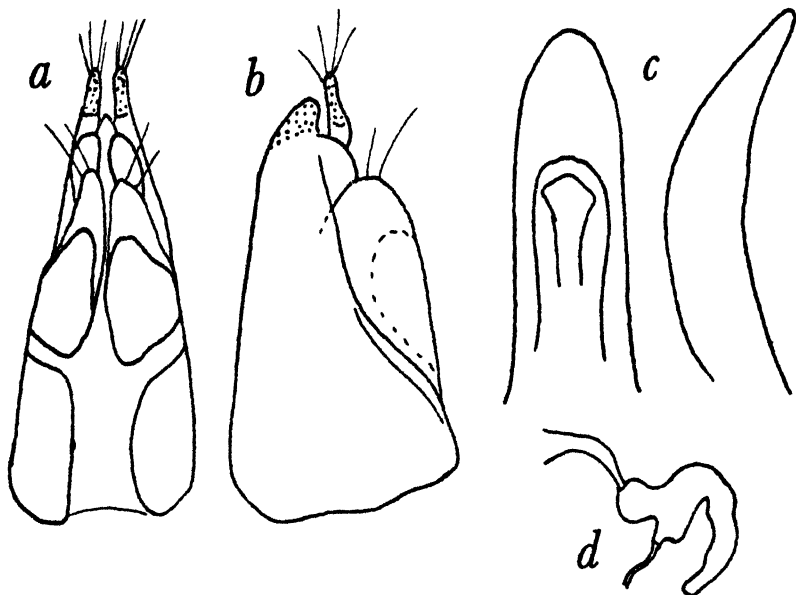


FIGURE 63.—*Amydrogmus variabilis* Pierce: *a*, Female genital tube, dorsal view; *b*, female genital tube, lateral view; *c*, median lobe of male genitalia, dorsal and lateral views; *d*, receptaculum seminis.

#### Genus OPHRYASTES Schoenherr

*Ophryastes* SCHOENHERR, 1833, 508. (Genotype, *Liparus sulcirostris* Say, original designation.)

[For characters of *Ophryastes* see discussion under *Eupagoderes*.]

#### KEY TO SPECIES OF OPHRYASTES

1. Transverse impression between rostrum and head evident; ridges above eyes usually large..... 2  
 Transverse impression vague or lacking, and where present due to the great development of the ridges between the rostral sulci; ridges above eyes not large..... 8
2. Punctures of elytral striae large, round, distinct basally; intervals convex..... 3  
 Punctures of elytral striae fine, equal in size; stria finely impressed; intervals less convex..... 6
3. Median sulcus of rostrum finely impressed..... 4  
 Median sulcus of rostrum broad apically..... 5
4. Marked with ocellate spots..... *ocellatus* (Van Dyke)  
 Without ocellate spots..... *shufeldti* Casey, and *wickhami* Sharp
5. Larger (11 to 16 mm.); tuberosity on side of prothorax prominent; tenth elytral stria distinct at basal one-third..... *latirostris* LeConte

Smaller (6.8 to 9.5); lateral tuberosity feeble; tenth stria obliterated.

- porosus** LeConte
6. Prothorax not tuberculate at sides, not constricted at base; punctures of elytral striae larger; median rostral sulcus broad, with a median carina. **symmetricus** Fall
- Prothorax with lateral tuberosities and more or less constricted at base; punctures of elytral striae larger; median sulcus broad, but lacking a median carina.----- 7
7. Base of elytra produced; elytral striae only moderately deep. **sulcistrotris** (Say)
- Base of elytra truncate; elytral striae very deep----- **sulcipennis** Casey
8. Elytral intervals narrow and subequal in width; striae punctures very large and shallow----- 9
- Alternate elytral intervals wider and elevated; striae punctures finer----- 10
9. Base of elytra with a short, necklike constriction----- **collaris** Champion
- Base of elytra without necklike constriction----- **tuberosus** LeConte
10. Lateral tuberosities of prothorax large, prominent; elytra inflated; punctures of elytral striae very large, unevenly spaced, giving a tuberculate appearance; cinereous, brown, or gray, with black markings; smaller, most specimens between 6 and 9 mm. long----- **ovipennis** Sharp
- Lateral tuberosities smaller; elytra more parallel; punctures of striae moderate and evenly spaced; gray or brown, alternate elytral intervals usually, and suture always, darker; larger, most specimens between 9.5 to 14 mm. long----- **vittatus** (Say)

#### OPHRYASTES WICKHAMI Sharp

#### FIGURE 64

*Ophryastes wickhami* SHARP, 1891, p. 88.

Form robust, dorsum rather flattened, sides of elytra subparallel. Color whitish through buff to gray, striae cinereous; three vague plumbeous vittae upon the pronotum. Scaly vestiture predominantly imbricate. Rostrum only moderately stout, slightly arched, not constricted basally beneath; median sulcus deep, rounded at bottom, narrowed abruptly at a deep longitudinal pit between the antennal insertions; often a nearly obsolete subsidiary lateral sulcus at either side of the median, so that the latter is wide, triangular, the base of the triangle toward the apex of the rostrum; lateral sulci subparallel, well defined. Transverse impression between head and rostrum present but not conspicuous; head and rostrum finely, sparsely punctate. Pronotum one-quarter or slightly more than one-quarter wider than long, widest at or slightly behind the middle; base about one-sixth wider than apex; sides rounded, in most specimens slightly tuberculate; disk obsoletely impressed at middle, very coarsely and rather closely punctate. Elytra about four-ninths longer than wide, widest behind the middle, usually very slightly produced at base; striae usually composed of large, shallow punctures not closely connected, although in some specimens the striae are narrow and deeply impressed; elytral intervals convex, alternate intervals very

slightly wider and more convex; setae large, suberect, flattened, tawny. Legs stout; front and middle tibiae minutely denticulate within; hind tibiae truncate at apex.

*Measurements in millimeters.*—Length 13.5 to 19.5.

*Female genitalia* (fig. 64, *a, b, c, e*).—Genital tube heavily chitinized. Apical plates distinct, the inner face of each produced in a sharp dorsal keel, their apices so bent as to fit into one another; coxites relatively small, slightly compressed dorsoventrally; styli small, borne upon membranous areas on the dorsal bases of the coxites, invisible from above or below. The interlocking of the two dorsal keels throws one half of the tube ahead of the other, the whole tube being slightly askew. Eighth sternite with outer corners broadly rounded, posterior margin nearly square, with a faint suggestion of an emargination at the midline.

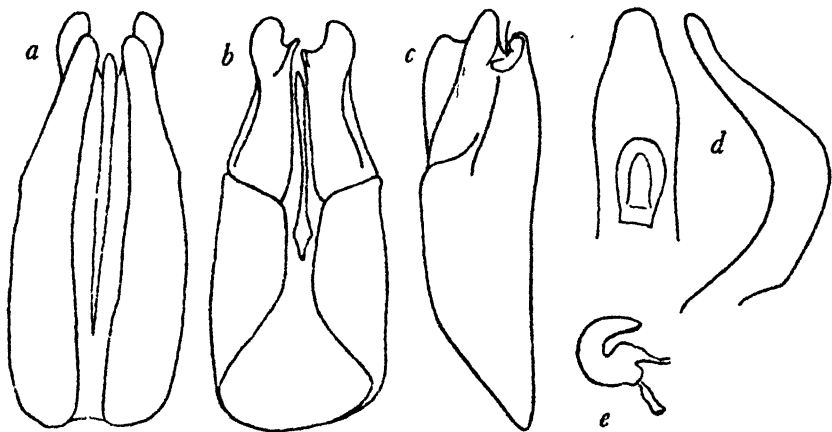


FIGURE 64.—*Ophryastes wickhami* Sharp: *a*, female genital tube, ventral view; *b*, female genital tube, dorsal view; *c*, female genital tube, lateral view; *d*, median lobe of male genitalia, dorsal and lateral views; *e*, receptaculum seminis.

*Male genitalia* (fig. 64, *d*).—Median lobe stout, sharply curved in profile, apex reflexed; in dorsal view sides slightly emarginate on either side of the median orifice, apex broadly rounded.

*Type locality.*—Winslow, Ariz.

Specimens from the following localities have been seen: ARIZONA, Winslow (Wickham). NEW MEXICO, Albuquerque; Coolidge (Wickham); Alamogordo; Old Laguna (H. A. Scullen). A single female specimen labeled "Cal" has been examined.

*Remarks.*—The collection of the U. S. National Museum contains two examples from Alamogordo, N. Mex., which are nearly white, the elytral striae alone being faintly tawny and marked with small but distinct ocellate darker spots, and the elytral scales less broadly overlapping than usual.

## OPHRYASTES SHUFELDTI Casey

*Ophryastes shufeldti* CASEY, 1888, p. 238.

Elongate-oval, convex, dorsum slightly flattened, sides of the elytra more parallel than in most species. Color cinereous, with a vague lateral vitta on either side of the pronotum and irregular spots along the elytral striae darker brown. Rostrum only moderately stout, slightly arched, not constricted basally beneath; median sulcus deep, narrow, rounded at bottom; lateral sulci subparallel, well defined. Head convex, front slightly flattened; transverse impression between head and rostrum distinct; head and rostrum finely, sparsely punctate. Pronotum a little more than one-fourth wider than long, widest slightly behind the middle, base one-third wider than apex; sides rounded; disk coarsely and moderately closely punctate, more closely toward the sides; median impression distinct. Elytra about four-ninths longer than wide, widest before the middle; striae impressed, punctures distinct, round; intervals convex; setae rather fine, suberect, tawny. Legs stout; front tibiae minutely denticulate within; hind tibiae truncate at apex.

*Measurements in millimeters*.—Length 13.

*Type locality*.—Fort Wingate, N. Mex.

*Remarks*.—A male in the Casey collection differs slightly from the female. (Cf. *ocellatus* Van Dyke.)

## OPHRYASTES OCELLATUS (Van Dyke)

*Eupagoderes ocellatus* VAN DYKE, 1934, p. 177.

Form robust, dorsum slightly flattened, sides of elytra subparallel. Color pearly gray, three stripes on the pronotum black, elytral suture sometimes golden brown. Rostrum moderately stout, elongate, not constricted beneath at base, rather sharply arched near apex above; median sulcus well marked, rounded at bottom, narrowed opposite the antennal insertion as in *O. wickhami* Sharp; lateral sulci short, well defined, slightly convergent at base of rostrum. Transverse impression between head and rostrum shallow, not conspicuous. Head rounded, front convex; head and rostrum finely and moderately closely punctate, with suberect white setae. Pronotum about one-fourth broader than long, base about one-fourth wider than apex; sides evenly rounded, with a suggestion of tuberosity; disk coarsely, rather closely punctate, median impression feeble. Elytra nearly twice as long as wide, widest behind the middle, usually not produced at base, not greatly inflated; elytral striae finely impressed, punctures coarse; intervals convex, alternate ones slightly wider but very slightly if at all more convex. Legs moderately stout; fore and middle tibiae minutely denticulate within, hind tibiae truncate at apex.

*Measurements in millimeters*.—Length 13–14.5 mm.

*Type locality*.—Grand Junction, Colo.

Reported also from Thompson, Utah. One specimen seen from Coolidge, N. Mex. The latter specimen was determined for me by Dr. Van Dyke as "*Eupagoderes ocellatus* Van D., var." It differs from the type as described above by having the scaly vestiture imbricate in the center of the elytra; by the darker color (although still with the ocellate spots); by the more abruptly arched apex of the rostrum; the slightly flattened front; the tawny, conspicuous setae, and in the elytral striae, which are not greatly if at all impressed. This specimen is a male. The genitalia are the same as those of *O. wickhami* Sharp. Upon comparing this specimen with a male of *O. shufeldti* Casey in the Casey collection, I find that they are identical except for the fact that *O. shufeldti* lacks the lighter centers in the elytral spots. I am unable to detect any real difference between *O. wickhami* Sharp, as represented in the several series examined, and *O. shufeldti* Casey, either externally or in the genitalia. I am inclined to consider both *wickhami* and *ocellatus* as individual variations, or at most minor races, of *shufeldti*. However, for the benefit of those who may disagree with me in this I have kept them separate. Because the genitalia are identical, only those of *O. wickhami* Sharp have been drawn.

*Remarks*.—*Ophryastes wickhami* Sharp was moved from *Ophryastes* (where it was originally placed) to *Eupagoderes*, on the basis of the pubescence of the fore tarsi of the male, and *O. ocellatus* was described as a *Eupagoderes*. As has been pointed out, the distinction between these two genera (and *Tosastes* for that matter) is largely one of convenience. From the general appearance and the genitalia of the three foregoing forms it seems that they could be placed to better advantage in *Ophryastes*.

#### OPHRYASTES LATIROSTRIS LeConte

##### FIGURE 65

*Ophryastes latirostris* LECONTE, 1853, p. 443.\*

Moderately robust. Color gray-white with large irregularly placed black or plumbeous blotches, which are more dense, even subcontinuous basally. Rostrum stout, moderately arched above, not or very slightly constricted at base beneath; median sulcus very broad, interrupted (except for a median fovea) by a transverse ridge about opposite the antennal insertions, and basally terminating abruptly at the junction of the rostrum and head; lateral sulci broad, moderately deep, more or less sharply convergent near base of rostrum. Head evenly rounded, front not flattened, separated from the rostrum by a very

\*[*Ophryastes validus* LeConte, 1854, p. 225, type locality "near Chihuahua," is usually treated as a synonym of *latirostris*.]

well marked transverse impression. Immediately posterior to this, in some specimens, there is a tubercle, or slight transverse ridge, upon the front. Supraorbital ridges moderate, a vague depression before each eye; head and rostrum moderately finely and closely punctate, with a fairly long white or yellowish seta in each puncture. Pronotum from two-fifths to a little less than one-half wider than long; base one-third to one-fourth wider than apex, fimbriate with brown or yellow scales; sides strongly tuberculate, each lateral ridge divided into several small tubercles at apex; disk coarsely and irregularly punctate, rugose, with small white or yellow setae in smaller secondary punctures upon the intervals. Median groove nearly or quite



FIGURE 65.—*Ophryastes latirostris* LeConte: *a*, Female genital tube, dorsal view; *b*, female genital tube, ventral view; *c*, female genital tube, lateral view; *d*, median lobe of male genitalia, lateral and dorsal views.

obsolete. Elytra moderately inflated, widest at basal one-third (female) or at middle (male); striae finely impressed (sometimes not impressed); punctures large, round, evenly spaced; intervals convex, 1 and 6 narrower, remainder subequal in width. Legs moderately stout; front tibiae not denticulate within; hind tibiae obliquely truncate at apex, the space covered with flat scales. Tarsi not pubescent beneath, but apices of lobes pointed, spinelike.

*Measurements in millimeters*.—Length 11–16.

*Female genitalia* (fig. 65, *a*, *b*, *c*).—Genital tube heavily chitinized; apical plates flattened, rounded at apex, inner edge raised in a high keel, the apex of which, when viewed from above, appears to be a tooth; coxites large, subconical; styli small, dorsolateral in position; eighth sternite broadly, obtusely emarginate at apex (more so than in *O. tuberosus* LeConte).

*Male genitalia* (fig. 65, *d*).—Median lobe stout; in profile apex rounded, portion immediately back of apex nearly straight, remainder evenly curved; as viewed from above rather deeply excavated; apex rounded, with a deep, obtuse emargination. A distinct keel runs from the apex to the median orifice upon the upper side.

*Type locality*.—Arkansas River, near the mountains.

This species has been recorded from the following localities: New Mexico, Albuquerque (H. Soltan); Gallup; 10 miles south of New Mexico State College. ARIZONA, Chiricahua Mountains (Hubbard and Schwarz); Winslow (M. Linell); Peach Springs (Wickham); Tucson. TEXAS, Alpine (Wickham); between Pecos River and Guadalupe Mountains. UTAH, Cedar (E. D. Ball); Callao (Tom Spaulding); Marysvale; Sevier Lake (Wickham). COLORADO, Canyon City (Wickham). IDAHO, Blackfoot (C. Wakeland) (E. S. G. Titus). OREGON.

The genitalia of this species, both male and female, indicate a rather close relationship to *O. wickhami* Sharp, but are easily distinguished from those of that species.

OPHRYASTES SYMMETRICUS Fall

FIGURE 66

*Ophryastes symmetricus* FALL, 1907, p. 260.

Robust, convex. Head with a narrow dark brown stripe and two rather wide lateral dark brown stripes passing beyond the eye to the insertion of the antennae, continuous with the pronotal stripe; remainder of head mixed gray, white, and brown; pronotum gray, yellowish on flanks, a lateral vitta each side dark brown; elytral intervals 1, 3, 5, and 7 brownish, alternate ones gray, brownish basally, with dark brown mottling along the striae. Rostrum stout, markedly arched above, somewhat constricted at base beneath; median sulcus subobsolete apically, and replaced by a median carina basally, which terminates at the junction of head and rostrum; lateral sulci wide, short, arcuate, convergent basally. Head and rostrum separated by a rather vague transverse impression. Head convex, very slightly flattened between the eyes, with a median groove extending to the vertex; eyes prominent, convex; head and rostrum moderately finely and rather closely punctate and rather thickly set with erect tawny or brown setae. Pronotum less than twice as wide as long, widest at or slightly before the middle, sides nearly evenly arcuate, not tuberculate; slightly constricted apically, anterior margin broadly arcuate, emarginate at center; basal margin slightly trisinate; median impression wanting; disk evenly, coarsely, and closely punctate and with erect tawny or brown setae. Elytra cordate, base truncate; striae fine, not impressed, punctures hardly visible; intervals 1 and 3 wider than 2 and 4 and elevated, intervals 5, 6, and 7 only slightly wider than 1 and 3 and much more elevated, especially at the base of the elytra, interval 8 flat, wide; setae conspicuous, semierect, brown. Legs moderately stout, tibiae not denticulate, but spinose apically, within; apices of hind tibiae rounded; tarsi elongate, two-thirds as



long as hind tibiae, each joint set with long, stout, black spines, especially at sides and apex.

*Measurements in millimeters.*—Length 10.5.

The foregoing description is that of the male type. The only other specimen known to me is a female in the collection of the U. S. National Museum. This specimen, while undoubtedly of the same species, differs from the type rather markedly in some respects. The front of the head is greatly depressed, with a median groove reaching to the vortex; elytra produced at base; humeri rounded but prominent; elytra intervals 1 and 3 narrower than 2 and 4 and elevated, intervals 5, 6, and 7 slightly wider than 1 and 3 and greatly elevated, so that the sides of the elytra are vertical. The predominating color is buff or light brown, with gray or dark brown markings. Length 13.4 mm.



FIGURE 66.—*Ophryastes symmetricus* Fall: *a*, Female genital tube, dorsal view; *b*, female genital tube, lateral view; *c*, eighth sternite of female.

*Female genitalia* (fig. 66, *a*, *b*, *c*).—Genital tube short, stout, not heavily chitinated; both apical plates and coxites prolonged into large, upward curving spines, appearing almost the same from either above or below; styli not visible at ordinary magnifications. Eighth sternite broadly, roundedly emarginate, the emargination involving the whole apex.

*Male genitalia.*—Not examined.

This species is unique in the form of the female genitalia, the rostral carina, and the extremely spinose tarsi.

*Type locality.*—Sante Fe, N. Mex. The female mentioned above is from Winslow, Ariz.

#### **OPHRYASTES SULCIPENNIS Casey**

#### **FIGURE 67**

*Ophryastes sulcipennis* CASEY, 1888, p. 239.

Form oblong, densely clothed throughout with a squamose dark brown indument, paler beneath and on the legs; alternate intervals of elytra slightly paler by certain reflections. Head moderate; beak very much longer than the head, and,

at apex, nearly as wide, fully one-half longer than wide, abruptly strongly dilated at apex, strongly trisulcate; sulci abruptly ending at the very deep and strongly marked transverse basal impression; middle sulcus very broad and deep, shallower anteriorly, becoming gradually narrower and deeper toward base, obsolete in apical two-fifths; lateral only present in basal half, narrow, deep, becoming slightly broader from apex to base; front convex, flattened above in the middle; antennae with dense piceous indument; first joint of funicle slightly longer than the next two together. *Prothorax* nearly twice as wide as long, widest at posterior third where the sides are very strongly rounded and prominent, thence strongly convergent and almost straight nearly to the apex, then abruptly constricted, strongly constricted near the base behind the lateral prominences; sides very minutely and unevenly notched at middle; base transverse, truncate, one-third wider than the apex; the latter broadly arcuate; disk broadly convex, slightly uneven, being broadly impressed anteriorly and laterally, coarsely and indefinitely ruguloso-punctate; median groove moderate, not well defined. *Elytra* oblong, rather acutely rounded behind from above, declivous posteriorly, but not perpendicular, slightly wider at apical third; sides nearly straight; humeri very broadly rounded; base transversely truncate; scutellum slightly prominent, triangular, wider than long, black, finely rugulose, dull; disk flattened above, strongly convex at the sides, less than one-half longer than wide, very slightly wider than the prothorax, deeply sulcate; sulci with very large, rather close, feebly defined impressed punctures; intervals but slightly wider than the sulci, very strongly convex, with small, slender, scattered setae. Length 13.0 mm.

*Type locality*.—Fort Wingate, N. Mex.

Except for its inclusion in the key to species, and the drawings of the male genitalia, no reference to *sulcipennis* was found among Davis's notes; the foregoing is taken from Casey's original description.]

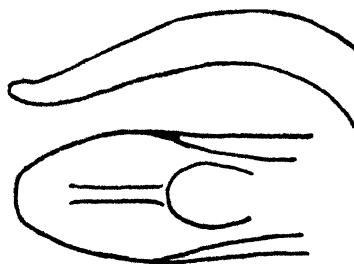


FIGURE 67.—*Ophryastes sulcipennis* Casey, median lobe of male genitalia, lateral and dorsal views.

#### OPHRYASTES SULCIROSTRIS (Say)

FIGURE 68

*Liparus sulcirostris* SAY, 1824, p. 316.

*Ophryastes ligatus* LeCONTE, 1853, p. 443.

Moderately robust, elytra inflated, dorsum convex. Color blackish or brown with irregular mottlings of black or brown on the head and elytra and a narrow median and two wider lateral stripes on the pronotum. Rostrum short, stout, well arched above, sharply constricted

at base beneath; median sulcus broad, usually quite deep, wider toward the apex of the rostrum; lateral sulci deep, arcuate, convergent toward the base of the rostrum; intersulcal ridges usually very large, flat. Head rounded, ridges above eyes prominent; punctation of head and rostrum very fine and sparse. Pronotum two-fifths wider than long, widest at middle or at basal two-fifths, base varying from very little to nearly one-fourth wider than apex; sides varying from evenly rounded to rough and tuberculate, constricted before base and apex; disk coarsely, sparsely punctate; median groove subobsolete. Elytra cordiform, about one-third longer than wide, base produced; striae finely impressed, punctures large, round, shallow, separate, usually at least partially obscured by the scaly covering; setae numerous, short, subrecumbent, white or yellow. Legs moderately stout; anterior tibiae not denticulate within; posterior tibiae obliquely truncate to rounded and not at all truncate.

*Measurements in millimeters.*—Length 6.2 to 11.

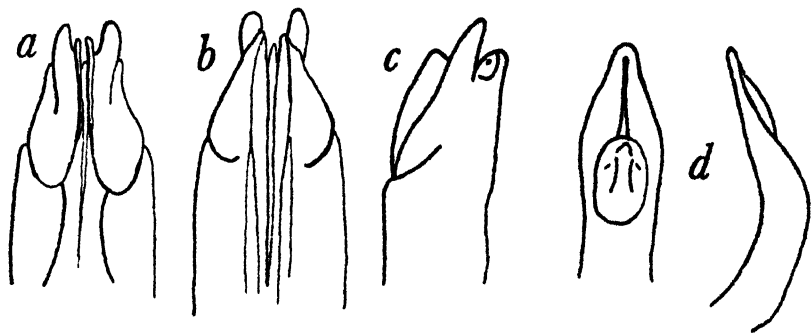


FIGURE 68.—*Ophryastes sulcirostris* (Say): *a*, Female genital tube, dorsal view; *b*, female genital tube, ventral view; *c*, female genital tube, lateral view; *d*, median lobe of male genitalia, dorsal and lateral views.

*Female genitalia* (fig. 68, *a*, *b*, *c*).—Genital tube tubular, moderately heavily chitinized; apical plates flattened, twisted out of horizontal plane, and rounded at apices, the inner edge of each raised into a narrow keel, which is more prominent apically; coxites moderate, a trifle flattened laterally, and subconical; styli extremely minute, hardly visible. Eighth sternite rather narrow, deeply obtusely emarginate at apex, the emargination rounded at bottom.

*Male genitalia* (fig. 68, *d*).—Median lobe rather strongly curved, extremely thin at apex, not deeply excavated above, with a thin keel on the dorsal midline reaching nearly to the apex.

*Type locality.*—Of *sulcirostris*, "Arkansa"; of *ligatus*, Nebraska. [The synonymy of *ligatus* LeConte with *sulcirostris* Say was proposed by Horn (1876, p. 31).]

Specimens of *sulcirostris* have been seen from the following localities: ARIZONA, Peach Springs (Wickham); Williams. NEW MEXICO, Al-

buquerque (H. Soltau); Magdalena (Strickler). TEXAS, Alpine (Wickham); Marfa (Wickham). UTAH, Dividend (Tom Spaulding); American Fork (Hubbard and Schwarz). COLORADO (Popenoe). MONTANA, Helena. IDAHO, Pocatello (Wickham).

[From a note which Davis had pinned into the National Museum collection it appears that certain specimens from the localities listed above are those which he had placed as *sulcirostris* with considerable confidence. In addition the Museum collection contains a good many specimens that Davis had examined and set aside as either *sulcirostris* (Say) or *porosus* LeConte, but which he had not yet placed more definitely. These specimens, which can be considered to belong to a *sulcirostris-porosus* complex, are from the following places: TEXAS, Marfa; Sweetwater; Big Springs. NEW MEXICO, Luna; Torrance County; Albuquerque; Koehler; near Koehler. ARIZONA, Peach Springs; Winslow; "Palm Spg." KANSAS and western Kansas. COLORADO, Canon City; Custer County; Bent County; Denver; Colorado Springs; La Junta; Fort Collins; Graham's Park. UTAH, Salt Lake. WYOMING, Cheyenne. IDAHO, Hagerman. MONTANA, Helena; Enid; Miles City; "Assinbne." NORTH DAKOTA, Bismarck. CANADA, Medicine Hat, Alberta.]

OPHRYASTES POROSUS LeConte

FIGURE 69

*Ophryastes porosus* LECONTE, 1854, p. 225.

The description of *O. sulcirostris* (Say) applies equally well to this species. The two species, although separable on genitalic characters of the female, are so closely related as to be practically indistinguishable on external characters. The character given by LeConte and Horn (1876, p. 30) for their separation does not hold through any considerable series, and in any case is very indefinite. It may be that the two forms represent the extremes of a single rather variable species, which are being arbitrarily divided; especially since the geographical ranges overlap. In general, from specimens seen so far, *porosus* seems to range not so far north as *sulcirostris*. The male genitalia are practically indistinguishable. The median orifice in *sulcirostris* is perhaps a little longer and the flap of the opening longer and narrower, the apex a little more pointed, and the keel not so prominent near the apex, but all these characters are subject to great variation.

*Measurements in millimeters.*—Length 6.8 to 9.5.

The female genitalia are much more easily distinguished, as shown in figures 68, *a, b, c* and 69, *a, b, c*. The apical plates of *sulcirostris* are flattened, twisted at an angle to the horizontal, and broadly rounded at the apices; the dorsal keel at each side of the midline is very promi-

nent, especially apically, terminating abruptly. In *porosus* the apical plates are somewhat larger in proportion, more twisted out of horizontal, the inner apical angle of each is sharper, and the dorsal keel is smoothly rounded as seen from the side, not terminating abruptly apically.

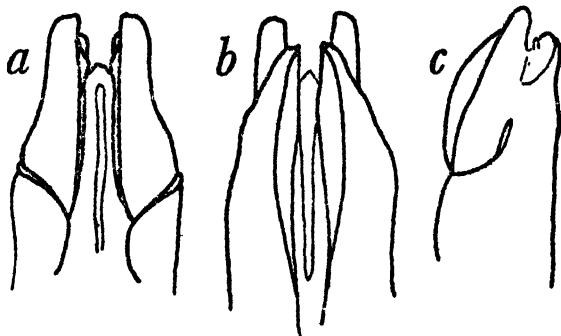


FIGURE 69.—*Ophryastes porosus* LeConte: *a*, Female genital tube, dorsal view; *b*, female genital tube, ventral view; *c*, female genital tube, lateral view.

*Type locality*.—"Near Chihuahua."

Specimens of this species have been seen from the following localities: "CAL." ARIZONA, Chiricahua Mountains (Hubbard and Schwarz). COLORADO, Denver (H. Soltau); Otero County. "NEB." CANADA, Medicine Hat, Alberta (F. S. Carr).

**OPHRYASTES COLLARIS** Champion

*Ophryastes collaris* CHAMPION, 1911, p. 319.

No specimen of this species has been seen. The following is a copy of the original description:

Moderately elongate, black; densely clothed with chalky-white or pale brownish scales, the head with a small patch on each side above the eyes, the prothorax with three spots at the apex, and the elytra with various irregular scattered patches, infuscate, the intermediate and posterior femora also fusco-annulate in front; the surface also set with minute, short, scattered hairs. Rostrum very broad, without definite transverse depression at the base, deeply trisulcate, the lateral grooves converging posteriorly, the flattened inter-ocular portion of the head also shallowly trisulcate. Prothorax strongly transverse, laterally bilobato-dilatate (the posterior lobe prominent and the prothorax here nearly or quite as wide as the elytra), constricted just before the base, the groove in front of the basal ridge deeply impressed laterally and obsolete in the middle; the depressed narrow basal portion angularly produced backwards in the middle; the surface uneven, sparsely, coarsely punctate. Elytra convex, oblong-oval, with a short, neck-like constriction at the base; coarsely punctate-striate, the interstices convex.

Length 9-12½, breath 4¼-5½ millim.

[*Type locality*.—Not definitely stated in original description.]

*Hab.* North America, Texas (coll. Fry.—Mexico, Nuevo Laredo in Tamaulipas (Höge).

Two specimens, assumed to be male and female, the Texan example (♀) being much broader than the other. Near *O. tetralobus*, but with the median groove of

the rostrum obsoletely extending to the inter-ocular portion of the head, the latero-anterior lobe of the prothorax less prominent, and the depressed basal portion of the prothorax more produced in the middle behind. The neck-like constriction to the base of the elytra separates *O. collaris* from *O. tuberosus*, *bituberosus*, and *basalis*, the last mentioned insect, moreover, having the median sulcus of the rostrum extending upwards. The dark markings may be partly due to abrasion or discoloration. Both examples are figured.

No representative of this species was available for study, so I have placed *collaris* in the key where it seemed to belong from the above description.

OPHRYASTES TUBEROSUS LeConte

FIGURE 70

*Ophryastes tuberosus* LeConte, 1853, p. 443.

Broadly elongate oval, dorsum slightly depressed. Head gray, pronotum gray-black, elytra gray-black, intervals 1 and 3 apically and 5 and 7 for nearly their entire length light ashy gray, legs light gray. Rostrum stout, not greatly arched at apex above, slightly or not at all constricted at base beneath; median sulcus deep, acute, wide, not interrupted by a fovea apically, and terminating at junction of head and rostrum; lateral sulci well defined apically, vague and broad basally, and continuing upon the head above the eyes, causing large "supra-orbital" ridges. Head evenly rounded, not separated from the rostrum by a transverse impression, although head and rostrum have slight separate convexities as viewed from the side, caused by the great development of the intersulcal ridges upon the rostrum; head and rostrum finely, or at most only moderately coarsely punctate. Pronotum two-fifths wider than long, base wider than apex, quadrate in outline, widest across basal tuberosities; tuberosities large, subequal in size; basal margin squarely transverse, apical margin rounded, produced in the center; punctuation of disk coarse and close, median sulcus of pronotum subobsolete. Elytra widest at about the middle, humeri lacking; punctures of elytral striae large, round, separate; interval 5 conspicuously wider and elevated, others subequal in width and slightly convex; setae extremely small and inconspicuous, white. Legs stout; anterior tibiae much curved, and terminated in a distinct hook; apices of hind tibiae rounded, not truncate. The foregoing description is that of the type in the LeConte collection.

*Female genitalia* (fig. 70, *a*, *b*, *c*).—Genital tube heavily chitinated; apical plates strongly curved downward, concave beneath, pointed at apices. The inner dorsal edge of each is raised into a thin keel extending to the apical one-half or two-fifths. Coxites large, rounded; styli small, placed upon large, semi-membranous areas upon the dorso-lateral faces of the coxites. Eighth sternite with the external corners rounded, and a large, obtuse emargination at apex.

*Male genitalia* (fig. 70, *d*).—Median lobe in lateral view strongly curved basally, nearly straight apically, heavily chitinized; in dorsal view slightly widening apically, apex rounded and emarginate; deeply excavated above, with a heavy keel along the midline from the median orifice to the apex. This keel is usually visible from the side.

*Measurements in millimeters*.—Length 8.5 to 13.5.

*Type locality*.—Santa Fe, N. Mex.

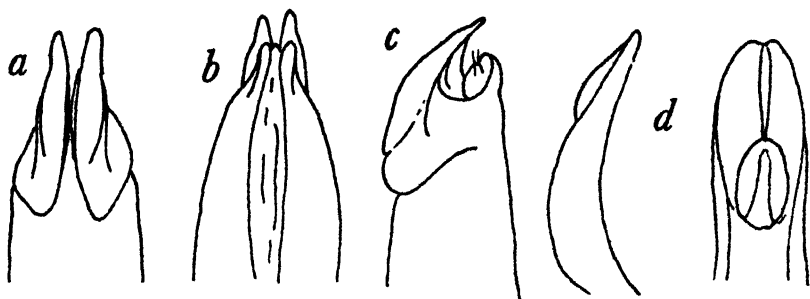


FIGURE 70.—*Ophryastes tuberosus* LeConte: *a*, Female genital tube, dorsal view; *b*, female genital tube, ventral view; *c*, female genital tube, lateral view; *d*, median lobe of male genitalia, lateral and dorsal views.

The type in the LeConte collection bears a dark green circular label which is supposed to indicate New Mexico. LeConte's series shows considerable variation in the punctuation of the elytra, the striae being impressed in some specimens. There is also great variation in the prominence of the lateral thoracic tuberosities. Specimens have been examined from the following localities: ARIZONA, Winslow (M. L. Linell). NEW MEXICO, Torrance County (J. R. Douglas); Albuquerque (H. Soltau); Estancia (J. R. Douglas); 10 miles south of New Mexico State College; Roswell; Sierra Blanca; Oro Grande; Las Cruces; Koehler (Wickham); Deming (Wickham), Maxwell. TEXAS, Alpine (Wickham); Hondo (J. D. Mitchell); El Paso (Wickham); San Diego (Hubbard and Schwarz); Sabinal (F. C. Pratt); Marfa (Mitchell and Cushman); Pecos (E. L. Diven); Sylvester. COLORADO, Holly (Wickham); Canyon City (H. Soltau). KANSAS, Garden City (F. H. Milliken); SOUTH DAKOTA, Cascade Falls. CANADA, Alberta, Medicine Hat (F. S. Carr).

The apices of the hind tibiae are usually rounded, not squarely truncate, although in some specimens they are definitely obliquely truncated. In color *tuberosus* varies from light, almost unicolorous gray, sometimes with ocellate plumbeous spots along the striae, through pinkish, strongly marked with chocolate brown, to uniform dull brown or nearly black. The median sulcus frequently extends up onto the front. So much variation in size, punctuation, and shape exists in this species that no external characters can be given other than those mentioned in the key.

## OPHRYASTES OVIPENNIS Sharp

## FIGURE 71

*Ophryastes ovipennis* SHARP, 1891, p. 90.

*Ophryastes bituberosus* PIERCE, 1909, p. 344 (not Sharp, 1891, p. 90) (misidentification).

Robust, convex, elytra inflated. Color brown or gray, pronotum usually with a median, and sometimes with two lateral, darker vittae; elytra irregularly marked with gray and black. Rostrum moderately stout, not greatly arched above, very slightly constricted at base beneath; median sulcus well defined, becoming vague apically and usually terminating at or before a median fovea about opposite the antennal insertions, continuing up onto the front basally, becoming deeper, and terminating usually in a fovea at or just before the upper level of the eyes; lateral sulci short, moderately broad and deep, straight or slightly divergent apically; intersulcal ridges well developed.

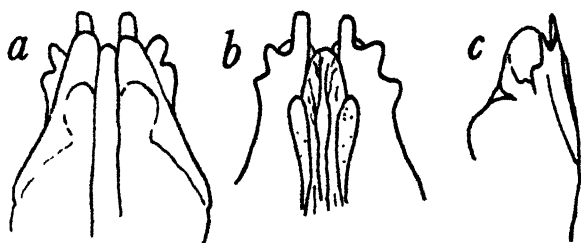


FIGURE 71.—*Ophryastes ovipennis* Sharp: a, Female genital tube, dorsal view; b, female genital tube, ventral view; c, female genital tube, lateral view.

Head evenly rounded, front dorsally continuous with rostrum; occasionally a vague depression on each side of the median sulcus, causing a slight supraorbital ridge, but usually with the sides of the head smoothly rounding to the eyes; head and rostrum extremely finely and sparsely punctate, with short, tawny setae. Pronotum varying from one-third wider than long to twice as wide as long; maximum width at posterior tuberosities; base from not at all to one-third wider than apex, squarely transverse, or slightly arcuate, fimbriate; apex sinuate; lateral tuberosity deeply emarginate at middle, the posterior half largest, sharp, subhamate behind; disk sparsely, very coarsely punctate at sides and along the wide, subobsolete median impression, and with a subimpunctate area at each side of the median groove; sparsely clothed with short, tawny, recumbent setae. Elytra broadly inflated, widest at basal one-fifth (♀) or one-third (♂), usually slightly produced at base; striae not impressed, consisting of deep, round, unconnected punctures placed in pairs, with an interval between each pair, giving the elytra a tuberculate appearance; intervals 3, 5, and 7 slightly wider, and greatly elevated basally, less so apically. Legs



short, rather stout; tibiae nearly straight, not denticulate within; posterior tibiae very sharply rounded but not truncate apically.

*Measurements in millimeters.*—Length 6 to 9.

*Female genitalia* (fig. 71, *a, b, c*).—Genital tube not very heavily chitinized; apical plates reduced, lightly chitinized, broadly rounded, thickly set with long hairs; coxites heavily chitinized, and enlarged into a broad, tridentate plate on each side; styli invisible.

*Male genitalia.*—Nearly identical with those of *O. vittatus*, but thinner, not quite so greatly curved, not so deeply excavated, and lacking all indication of a ventral keel.

*Type locality.*—Paso del Norte, Mexico.

Specimens of *ovipennis* have been seen from San Diego, Garrison, Bexar, Goliad, Beeville, Bowie, Del Rio, and El Paso, all in Texas.

*Remarks.*—In this species the teeth of the coxites are shorter and not as stout as in *O. vittatus*. They tend to be flat or to recurve downward, whereas those of *vittatus* are evenly concave upon the upper side.

#### OPIHRYASTES VITTATUS (Say)

##### FIGURE 72

*Liparus vittatus* SAY, 1824, p. 316.

Color dark to light gray, pronotum trivittate with dark brown, elytra with the suture nearly always and intervals 3, 5, 7, and 9 usually more or less completely dark brown. Rostrum continuous with the head, moderately stout and not greatly dilated at apex or greatly arched dorsally near apex; median sulcus broad, deep, with tawny imbricate scales at bottom, narrowing somewhat and becoming shallower at junction of head and rostrum and extending up onto the front nearly to the vertex; lateral sulci very broad and deep, with imbricate scales at bottom, nearly straight; rostrum and head extremely finely and sparsely punctate, or practically impunctate. Pronotum almost exactly twice as wide as long, widest at basal third, base about one-eighth wider than apex, apex dorsally slightly produced, base dorsally sinuate and fimbriate with scales; sides tuberculate, with a large basal and a smaller apical tubercle; disk coarsely, rather sparsely punctate, and rugose; median impression fine, sometimes interrupted, but nearly always present. Scutellum usually well exposed, transverse. Elytra inflated (female) or not greatly inflated (male); striae moderately finely impressed, punctures large, round, deep, and separated; elytral intervals subequal in width, the sutural and 3, 5, 7, and 9 slightly elevated; sutural intervals with fine punctation and numerous fine, short, white or tawny setae; setae practically lacking elsewhere on elytra. Legs fairly stout, anterior tibiae greatly curved near apex, posterior tibiae varying from subtruncate to evenly rounded; tarsi with joints 1 to 3 of about equal width, the third joint

of the tarsi of the fore and middle legs with adhesive pubescence, at least in the male.

*Measurements in millimeters.*—Length 9.5 to 14.1; width 4.4 to 6.6.

*Female genitalia* (fig. 72, *a, b, c*).—Eighth sternite slightly produced at outer corners, broadly rounded, and obtusely emarginate and hairy at apex. Genital tube slightly flattened dorsoventrally, apical plates ventral, their dorsal faces concave and each divided into three large teeth.

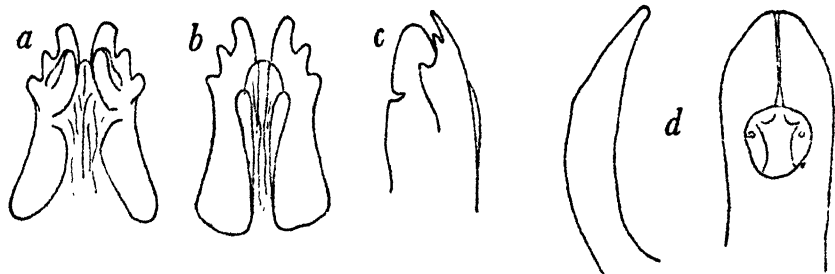


FIGURE 72.—*Ophryastes vittatus* (Say): *a*, Female genital tube, dorsal view; *b*, female genital tube, ventral view; *c*, female genital tube, lateral view (dorsum to left); *d*, median lobe of male genitalia, lateral and dorsal views.

*Male genitalia* (fig. 72, *d*).—Median lobe in profile fairly sharply curved, especially near the base, and rather thick; as viewed from above wide, somewhat dilated at about apical third, rather deeply excavated, and with a minute but distinct keel from the median orifice to the apex. An indication of a keel ventrally also, at point of greatest curve.

*Type locality.*—"Arkansa."

This seems to be the most widely distributed species of the genus. I have the following records of capture: ARIZONA, Winslow. NEW MEXICO, Maxwell, Koehler, Estancia, Torrance County. COLORADO, Colorado Springs, Holly, Pueblo, Berkeley, Greeley. KANSAS, "Western Kansas." OKLAHOMA, Lawton. TEXAS, Marathon, Abilene, Brownsville. The species is also found in Nevada.

#### Genus TOSTASTES Sharp

*Tosastes* SHARP, 1891, p. 91. (Genotype, *Tosastes globipennis* Sharp. Designated by Pierce, 1913, p. 375.)

The characterization of the genus given by Sharp is as follows:

Tarsi articulo tertio vix lobato, subtus absque pubescentia. Tibiae posteriores ad apicem simpliciter laminatae, nullo modo truncatae.

This genus has an appearance very different to *Ophryastes*, though it appears to be closely allied thereto; as, however, the apices of the hind tibiae are without any trace of truncature, or of a second row of spinules, it is perhaps advisable to treat the two forms as distinct genera. I cannot detect any other difference of true generic importance, though there are several minor peculiarities. The second ventral is quite short, the first suture straight, the third and fourth seg-

ments very short. The body is covered with overlapping scales as in *Ophryastes*. The ocular lobes are well developed.

As remarked above, the facies is very different from *Ophryastes*; had it not been for this I should not have separated the two, as the corbels of the hind tibiae are in this group in a transitory condition, and differ from species to species.

Since the above was written, species have been described in which there are two rows of spines upon the apex of the hind tibiae, and a definite suggestion of truncature. In spite of the fact that the appearance of most of the species of *Tosastes* is very different from that of the species of other genera, it seems impossible to lay down any real definition of the genus. The characters given for separation must all be considered, and considerable allowance made for variation.

In general, *Tosastes* is smaller, the elytra much more inflated, and the rostrum not deeply sulcate.

The proportions of the ventral segments are too variable and too nearly those of *Ophryastes* and *Eupagoderes* to be relied upon.

Pierce (1913, pp. 373, 374) uses the short second ventral segment, the narrow and nonpubescent third tarsal joint, the nontuberculate sides of the thorax, and the laminate tips of the posterior tibiae for separating *Tosastes* from other genera of the group. In *T. coarctatus* Champion the pronotum is nearly if not quite as wide as the elytra in some specimens and is subtuberculate, nearly tuberculate enough to be confusing, and the third joint of the anterior tarsi is wider than the second, and sometimes bears a small patch of what appears to be pubescence. Some species, or at any rate, some specimens, of both *Eupagoderes* and *Ophryastes*, have spinules more or less well developed upon the apices of the hind tibiae.

While the genitalia vary from one species to another, there seems to be no good genitalic character that applies well enough to them all to give a reliable point upon which to base the separation of this genus from the others.

Keys for the separation of the species of *Tosastes*, both by external characters and by the genitalia, follow. In the type of *Tosastes ovalis* Pierce the second row of spines on the apex of the hind tibia is present, but so very small as to be difficult to make out with a magnification of 20 diameters. Other specimens of this species leave one in doubt as to the presence or absence of spines at a magnification of 50 diameters, and it may be that the second row of spines is lacking in these. For this reason the use of this character has been avoided in the key as far as possible.

#### KEY TO SPECIES OF *TOSTASTES* BY EXTERNAL CHARACTERS

1. Elytra with acute humeral angles..... 2  
    Elytra with broadly rounded humeri..... 3
2. Humeral angles prominent, dentiform; sides of prothorax abruptly  
    constricted before the base..... *coarctatus* Champion

- Humeral angles minute; sides of prothorax less abruptly constricted before the base.....*humeralis* Sharp
3. Strial punctures of elytra long, fine, connected.....*globularis* Pierce  
Strial punctures of elytra large, rather shallow..... 4
4. Posterior tibiae rounded externally and tipped with a single row of spines... 5  
Posterior tibiae subtruncate and tipped with a double row of spines..... 6
5. Elytral striae finely impressed, punctures large and shallow....*ovalis* Pierce  
Elytral striae consisting of large, shallow, unconnected punctures.  
*globipennis* Sharp
6. Pronotum slightly less than twice as wide as long.....*ovalis* Pierce  
Pronotum about two-fifths wider than long.....*cinerascens* Pierce

## KEY TO FOUR SPECIES OF TOSASTES BY FEMALE GENITALIA

1. Apical plates very large, concave above; eighth sternite with a truncate tooth at each posterolateral angle, and bidentate or tridentate separate median plate at apex.....*cinerascens* Pierce  
Apical plates small or only moderately large; eighth sternite without median plate at apex..... 2
2. Eighth sternite produced at apex, and sharply emarginate; apical plates broadly rounded at apex.....*ovalis* Pierce  
Eighth sternite not produced at apex; apical plates sharper at apex..... 3
3. Apical plates acute at apex, coxites large; stipes long and laterally flattened; eighth sternite acute, emarginate at apex; ramus and ductus receptaculi of receptaculum seminis pressed closely together.....*globularis* Pierce  
Apical plates broadly rounded at apex; coxites smaller; styli greater in diameter and subcylindrical; eighth sternite broadly, evenly rounded and emarginate at apex; ramus and ductus receptaculi of receptaculum seminis with a space between them.....*coarctatus* Champion

## KEY TO FOUR SPECIES OF TOSASTES BY MALE GENITALIA

1. Median lobe dilated near apex..... 2  
Median lobe not dilated near apex..... 3
2. Median lobe only slightly dilated, only slightly excavated above, and with a carina from the median orifice to the apex; apex rounded or truncate.  
*coarctatus* Champion  
Median lobe broadly dilated, spoon-shaped, deeply excavated above; dorsal carina lacking; apex produced and slightly emarginate.....*ovalis* Pierce
3. Profile (lateral) of apical half of median lobe thin, nearly straight, slightly recurved at apex; median orifice oval.....*cinerascens* Pierce  
Profile of median lobe thicker, evenly curved to apex, not recurved; median orifice somewhat pointed apically, more truncate basally.  
*globularis* Pierce

## TOSASTES COARCTATUS Champion

## FIGURE 73

*Tosastes coarctatus* CHAMPION, 1911, p. 319.

Black, densely clothed with imbricate white scales. Rostrum stout, separated from the front by a transverse impression, and greatly arched dorsally near the apex; median sulcus distinct, finely impressed, broadening at each end, terminating abruptly at the transverse impression; lateral sulci short, broad, tending to converge at base of rostrum; intersulcal ridges prominent; scar of deciduous cusps of mandibles almost as prominent as in *T. cinerascens* Pierce.

Front more or less flattened. Pronotum from one-fourth to one-third wider than long, widest at basal two-fifths; from one-fourth to two-thirds wider at base than at apex; disk very coarsely punctate, sufficiently so as to be rugose, median impression subobsolete; sides tuberculate, abruptly constricted just before the base, thence dilated

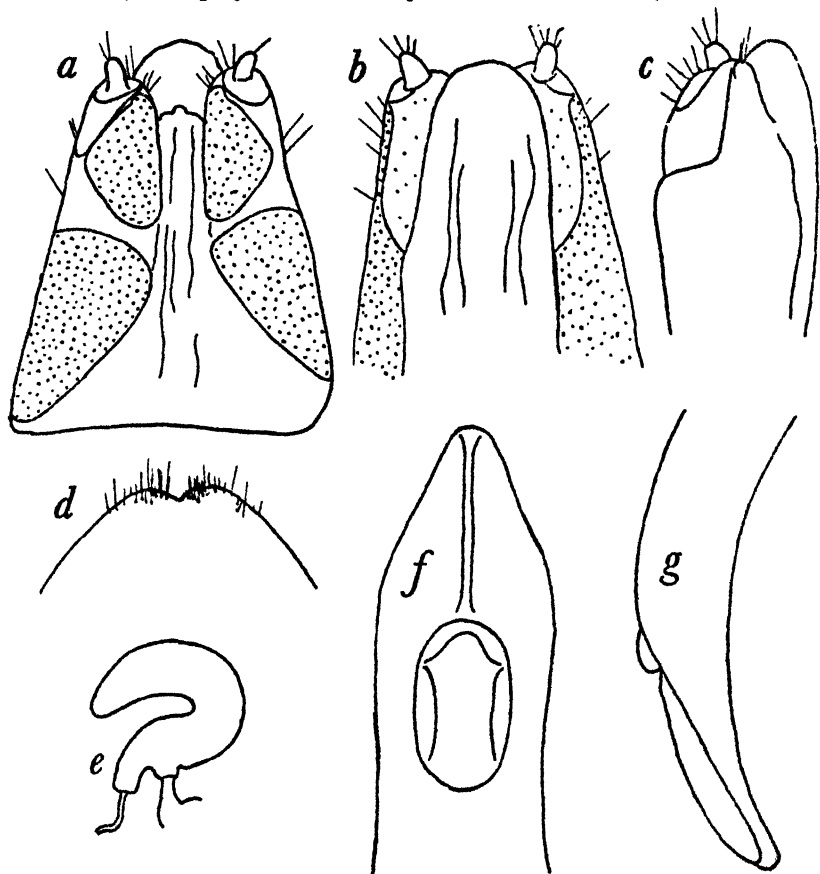


FIGURE 73.—*Tosastes coarctatus* Champion: *a*, Female genital tube, dorsal view; *b*, female genital tube, ventral view; *c*, female genital tube, lateral view; *d*, eighth sternite of female; *e*, receptaculum seminis; *f*, median lobe of male genitalia, dorsal view; *g*, median lobe of male genitalia, lateral view.

into a coarse, obtuse tooth on each side; apical margin slightly advanced, evenly arcuate, basal margin slightly retracted. Elytra widest at or slightly before the middle, oval, with prominent dentate humeri; striae not very sharply impressed, the punctures large, shallow; intervals subequal and nearly flat. Legs moderately stout; posterior tibiae rounded and with a single row of spines at apex; anterior tarsi of male with the third joint wider than the second, and, in some specimens, with a tiny patch of what appears to be adhesive pubescence upon the bottom of each lobe.

*Measurements in millimeters.*—Length 5.2 to 8.6; width 2.7 to 4.4.

*Female genitalia* (fig. 73, *a, b, c, d, e*).—Wedge-shaped, apex truncate, dorsoventrally flattened, not heavily chitinized; apical plates flat, broadly rounded at apex. Coxites very large; styli large. Eighth sternite rounded, emarginate at apex.

*Male genitalia* (fig. 73, *f, g*).—Median lobe in profile, evenly and not greatly curved, thick. From above very slightly dilated at apical two-fifths, thence tapering to an acutely rounded apex. There is a thin, high median carina, or keel, from the median orifice to the apex, dorsally, which is conspicuous from above or from the side.

*Type locality.*—Monclova, Coahuila, Mexico.

*Remarks.*—This species may be distinguished from any other except *T. humeralis* by the acute humeri. From that species it may be separated by the abruptly constricted sides of the thorax, with a tooth at the side, at base, and by the more prominent humeri. The specimens examined were collected by E. A. Schwarz and F. C. Bishopp.

#### TOSTASTES HUMERALIS Sharp

*Tosastes humeralis* SHARP, 1891, p. 91.

I have seen no specimen of this species. Sharp's original description follows (Latin diagnosis omitted):

Covered with thin scales, which on the anterior parts are almost entirely fused into a continuous indument, bearing also some scanty, very short setae. Rostrum short, with a broad median groove and a large lateral impression on each side. Thorax strongly transverse, very deeply rugose. Elytra quite truncate at the base, and with the angles minutely prominent; very closely applied to the base of the thorax, and of exactly the same width, so that the two are almost continuous in outline; the sculpture consists of vague, large depressions, placed in series, and connected by obscure striae. Spinules at the apex of the hind tibiae excessively short and broad, and very few in number. Two specimens.

"Long. cumque rostro 7-8 millim."

*Type locality.*—Chihuahua City, Mexico.

#### TOSTASTES GLOBULARIS Pierce

##### FIGURE 74

*Tosastes globularis* PIERCE, 1909, p. 344.

Shape much as in *T. cinerascens* Pierce. Gray or dark brown, head with brown and black mottlings, pronotum with a wide black median stripe, elytra with various markings of ashy gray and black. Rostrum stout, constricted at base beneath, continuous with head above; median sulcus lacking; lateral sulci short, subobsolete; scars of deciduous cusps of mandibles much less prominent than in *T. cinerascens*, nearly flush with the lateral face of the mandibles. Front slightly flattened. Head and rostrum smooth, nearly or quite impunctate, and with sparse, minute setae. Pronotum nearly a third wider than

long (1.1×1.8 mm.), base about a fourth wider than the apex (1.1 : 1.6 mm.), apex very slightly produced and slightly sinuate, base straight, sides evenly rounded; disk very lightly and sparsely punctate; median impression sharp, distinct. Elytra greatly inflated, wider at base than the base of the pronotum, humeri rounded; striae finely impressed, strial punctures shallow; intervals slightly convex, with subrecumbent tawny setae. Legs moderately robust; posterior tibiae rounded at apex, with a single row of spines.

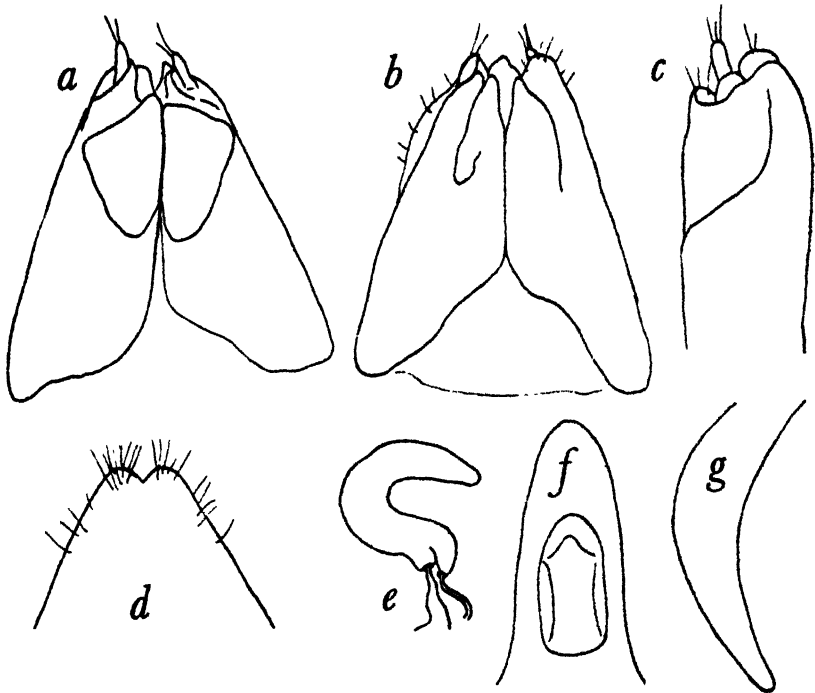


FIGURE 74.—*Tosastes globularis* Pierce: *a*, Female genital tube, dorsal view; *b*, female genital tube, ventral view; *c*, female genital tube, lateral view; *d*, eighth sternite of female; *e*, receptaculum seminis; *f*, median lobe of male genitalia, dorsal view; *g*, median lobe of male genitalia, lateral view.

*Measurements in millimeters.*—Length 5.0 to 6.6; width 2.7 to 3.5.

*Female genitalia* (fig. 74, *a*, *b*, *c*, *d*, *e*).—Eighth sternite triangular as viewed from below, deeply acutely emarginate at apex. Genital tube dorsoventrally compressed, subpyramidal as seen from above or below; apical plates very small, short, acute at apex; coxites large; styli very large. Receptaculum seminis stout, broadly rounded, ramus and ductus receptaculi very closely pressed together.

*Male genitalia* (fig. 74, *f*, *g*).—Median lobe in profile moderately, evenly curved, tapering regularly to a rather thick, rounded apex. From above, widest at base, sides gradually converging to apical

fourth, thence more rapidly to an acutely rounded apex; median orifice broadly oval, subtruncate basally, three-sevenths longer than wide.

*Type locality*.—Albuquerque, N. Mex. No specimens have been seen from other localities.

*Remarks*.—From *T. ovalis* Pierce, which it resembles closely superficially, the present species may be distinguished by the lack of a transverse impression at the base of the rostrum, and the finely and sparsely punctate pronotum, with its sharper median impression. The strial punctures are finer, the striae finely impressed, and the intervals less convex. From *T. coarctatus* Champion it may be distinguished by the rounded humeri.

**TOSTASTES OVALIS** Pierce

**FIGURE 75**

*Tosastes ovalis* PIERCE, 1909, p. 345.

Black, covered uniformly with gray-white imbricated scales, base of head dorsally yellowish white. Rostrum quadrate in cross section, stout, somewhat narrowed at base beneath and at sides; median sulcus short, interrupted, fine, or entirely lacking; lateral sulci short, rather vague, converging sharply at base of rostrum to form a transverse groove (in some specimens the inturned ends fail to reach the center, and no transverse impression is therefore evident in profile view). Front flattened, ridges above eyes prominent. Head and rostrum practically impunctate. Pronotum slightly less than twice as wide as long, base one-fifth wider than apex, sides evenly arcuate; anterior margin slightly produced, posterior margin transverse, very slightly sinuate; disk deeply, coarsely, and rather sparsely punctate; median impression vague, subobsolescent in some specimens. Elytra inflated, widest before the middle; striae fine, their punctures large and shallow; interspaces with white or tawny subrecumbent setae. Legs moderately stout, apices of hind tibiae subtruncate, with two rows of spines, the outer row short, sometimes absent.

*Measurements in millimeters*.—Length 5.2 to 6.8; width 3.0 to 4.0.

*Female genitalia* (fig. 75, *a, b, c, d, e*).—Genital tube slightly laterally compressed, base wider than apex as viewed from above, unevenly chitinized, semimembranous with rods of chitin apically. Apical plate of moderate size, broadly rounded, coxites large; styli large; seminal receptacle large, sharply curved, the nodus globular, the ductus receptaculi long, cylindrical, and the ramus practically nonexistent.

*Male genitalia* (fig. 75, *f, g*).—Median lobe heavily chitinized, as seen in profile, thick, slightly curved near base, apical two-thirds nearly straight; from above, apical half broadly dilated, very deeply excavated, margins sinuate, apex broadly rounded, very slightly emar-



ginate at midline; median orifice regularly oval, slightly narrowed toward the base.

*Type locality*.—Devils River, Tex.

Specimens are at hand from Marathon, Tex. (J. D. Mitchell and R. A. Cushman), and from Sulphur Spring Valley, Ariz. (Hubbard and Schwarz).

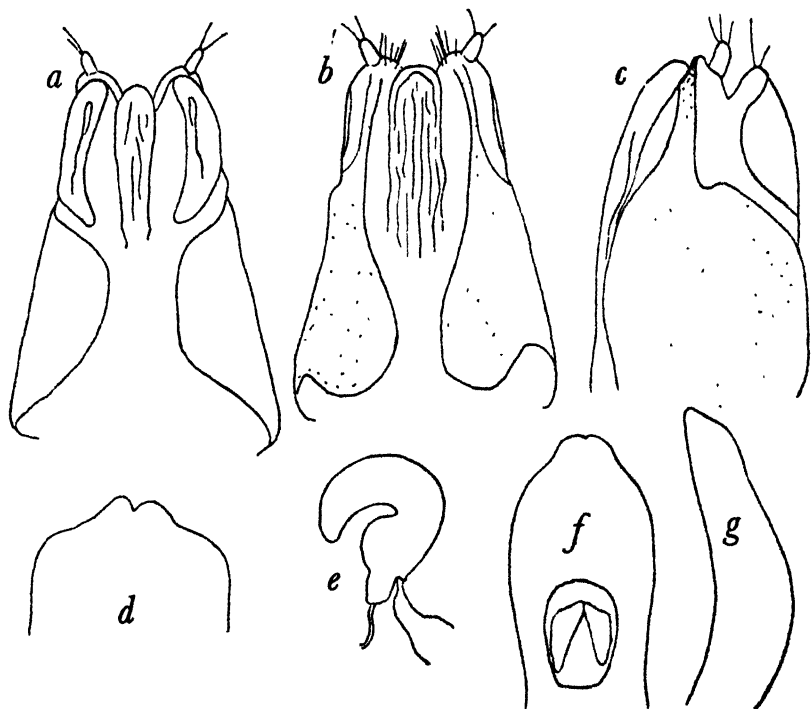


FIGURE 75.—*Tosaster ovalis* Pierce: *a*, Female genital tube, dorsal view; *b*, female genital tube, ventral view; *c*, female genital tube, lateral view; *d*, eighth sternite of female; *e*, receptaculum seminis; *f*, median lobe of male genitalia, dorsal view; *g*, median lobe of male genitalia, lateral view.

*Remarks*.—This species may be distinguished from *T. globipennis* Sharp, nearest to which it falls in the key, chiefly by the less inflated form and the more finely impressed elytral striae. Specimens which have the double row of spines plainly evident upon the apex of the hind tibia are easily distinguished by this character.

#### TOSASTES GLOBIPENNIS Sharp

*Tosastes globipennis* SHARP, 1891, p. 91.

Three specimens in the collection of the United States National Museum, one from San Carlos, Ariz. (J. C. Bradley), and two from Palmerlee, Ariz. (H. A. Wenzel), answer closely to the description of this species as published. All three specimens have genitalia

which seem to be identical with those of *T. ovalis* Pierce. The three were sent to Gilbert Arrow, of the British Museum, for comparison with the type, with the suggestion that *T. globipennis* might prove to be identical with *T. ovalis*. The following note was received from him:

Sir Guy Marshall has examined the specimens of *Tosastes* and compared them with the unique type of *T. globipennis*. He finds slight differences, the value of which it is not possible to decide without seeing a larger number of specimens, but which appear to him to make it undesirable for the present to sink either name.

No comparison of genitalia was made.

The two forms appear to be closely related, and may eventually be found to intergrade.

*Type locality*.—Guaajuco, Nuevo León, Mexico.

*TOSASTES CINERASCENS* Pierce

FIGURE 76

*Tosastes cinerascens* PIERCE, 1913, p. 376.

Head fulvous at base, gray on front and sides, rostrum gray, a wide median black stripe from vertex nearly to apex of rostrum. Pronotum gray with scattered pinkish iridescent scales, a moderately wide median black stripe, and sometimes a trace of a lateral vitta on each side. Elytra confusedly mottled with ashy gray, black, and light gray-brown. Scales imbricate throughout. Rostrum quadrate in cross section, not greatly broadened in either direction at apex, evenly curved dorsally and not, or hardly, arched at apex; separated from the front by what seems in profile to be a vague transverse impression, but what is really a flattening of the front; median sulcus extremely fine, or reduced to a mere flattening of the dorsal surface of the rostrum; lateral sulci extremely vague, short, and shallow; bases or scars of the deciduous cusps of the mandibles round, extremely prominent, the flattened face of the scar turned slightly outward; head and rostrum with fairly close, short setae. Pronotum about two-fifths wider than long ( $1.3 \times 2.0$  mm.), widest at about the apical third, wider at base than at apex ( $1.5:1.8$  mm.); disk coarsely, closely punctate; median impression fine. Elytra greatly inflated, wider at base than the base of the thorax, widest at about basal third; striae consisting of rows of large, round, shallow punctures; interstices elevated, with subrecumbent whitish setae. Legs rather stout, posterior tibiae truncate at apex, with a double row of spines.

*Measurements in millimeters*.—Length 4.2 to 6.0; width 2.0 to 3.4.

*Female genitalia* (fig. 76, *a, b, c, d, e, f*).—Eighth sternite quadrate at apex, with a truncate tooth at each outer corner and a thin median apical crest or plate, raised and projecting beyond and beneath the

apex of the sternite, sinuate and tridentate at apex. Genital tube dorsoventrally flattened, sides subparallel; apical plates short, large, concave above; styli very small, flat, set upon the dorsal inner bases of the apical plates. Receptaculum seminis sharply curved, nodulus large, ramus and ductus receptaculi close together but distinct, the ductus longer and pointed.

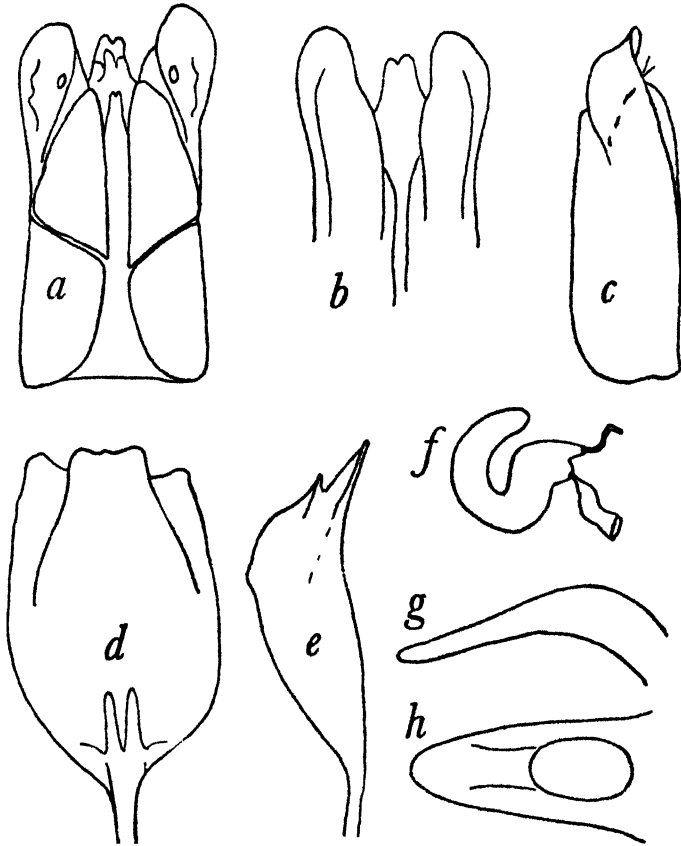


FIGURE 76.—*Tosastes cinerascens* Pierce: *a*, Female genital tube, dorsal view; *b*, female genital tube, ventral view; *c*, female genital tube, lateral view; *d*, eighth sternite of female, ventral view; *e*, eighth sternite of female, lateral view; *f*, receptaculum seminis; *g*, median lobe of male genitalia, lateral view; *h*, median lobe of male genitalia, dorsal view.

*Male genitalia* (fig. 76, *g*, *h*).—Median lobe moderately heavily chitinized; in profile the basal half rather sharply curved, apical half thin, nearly straight, slightly recurved at apex; from above, sides converging from base, converging more sharply about apical fourth, apex rounded; lobe very shallowly excavated apically; median orifice oval.

*Type locality*.—Wenatchee, Wash.

I have seen specimens from the following localities, all in Washington, and all collected during April and May; Mesa (M. C. Lane); Lind (M. C. Lane); Ritzville (M. C. Lane); Ellensburg (W. W. Baker); Okanogan; Riparia; Hanford; Wenatchee; Oroville; Tonasket; Mabton.

*Remarks.*—This species may at present be distinguished by the locality alone. The structure of the eighth sternite of the female is unique in the genus. The more convex elytral intervals and the narrower pronotum serve to distinguish this species from *T. ovalis* Pierce.

[Davis's work on *Rhigopsis* evidently had not been completed, and the status of the three named forms remains to be worked out.

#### Genus RHIGOPSIS LeConte

*Rhigopsis* LeConte, 1874, p. 459. (Genotype, *Rhigopsis effracta* LeConte (monobasic).)

Horn's characterization of the genus (1876, p. 36) follows:

Rostrum quadrangular, slightly longer than the head, dilated at tip and obliquely truncate above, upper surface deeply trisulcate, tip feebly emarginate. Mentum slightly retracted. Scrobes deep, well-defined, slightly arcuate in front, directed toward the lower border of the eye. Eyes narrow, acute beneath. Antennae moderate, scaly, scape gradually stouter attaining the margin of the eye; funicle 7-jointed, first two joints longer, stouter and nearly equal, 3-7 short, gradually broader, club oval, indistinctly articulated. Ocular lobes prominent. Scutellum indistinct. Elytra oval, feebly conjointly emarginate, humeri prominent, tuberculate. Metasternal side pieces connate with the body without suture. Hind coxae very widely distant, intercoxal process broad, truncate. Second segment of abdomen longer than the two following united, separated from the first by a strongly arcuate suture. Tibiae not mucronate at tip, corbels of hind tibiae feebly cavernous. Tarsi spinous beneath third joint feebly emarginate, not wider than the preceding. Claws moderate, free. Body densely covered with scales, almost entirely obscured by exudation coating.

So far as found, Davis's notes contained no reference to *Rhigopsis scutellata* Casey (1888, p. 242), type locality, Los Angeles County, Calif., apparently because he held the generally accepted opinion that *scutellata* is a synonym of *effracta*. This synonymy was first proposed by Horn, 1894, p. 442, in the following words:

An examination of my series of *R. (higopsis) effracta* shows that *R. scutellata* Casey cannot be retained as distinct, the species having doubtless been described from females. The scutellar character has no value, as several of my specimens have the scutellum entirely concealed by the elevations near it.]

#### RHIGOPSIS EFFRACTA LeConte

##### FIGURE 77

*Rhigopsis effracta* LeConte, 1874, p. 459.

Moderately robust, slightly flattened. Color varying from silver-gray with suture and a narrow median stripe upon the pronotum

darker, to very dark gray-brown with two narrow light gray stripes upon head and pronotum, carried back upon the second elytral stria a short distance, and with a few irregular lighter mottlings upon the elytra. Partially denuded specimens may be more or less uniform gray-brown. Rostrum robust, constricted basally beneath, evidently arched above; median sulcus narrow, deep, interrupted at apical fourth, whence it becomes a small median carina upon the apex of

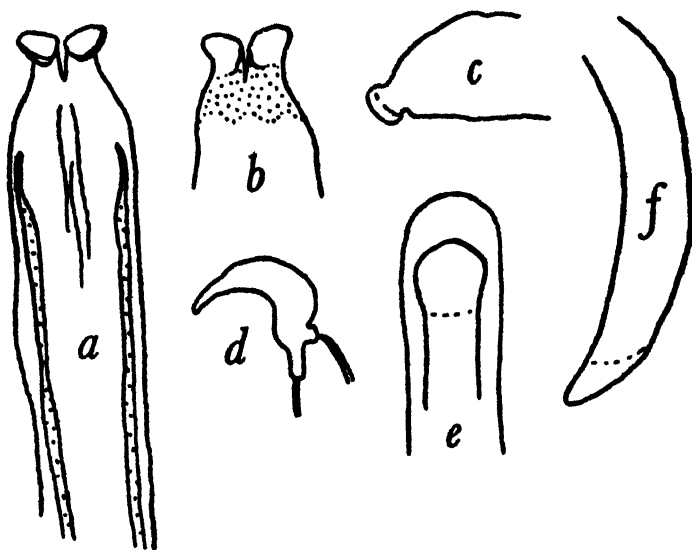


FIGURE 77.—*Rhigopsis effracta* LeConte: *a*, Female genital tube, dorsal view; *b*, apex of female genital tube, ventral view; *c*, apex of female genital tube, lateral view; *d*, receptaculum seminis; *e*, median lobe of male genitalia, dorsal view; *f*, median lobe of male genitalia, lateral view.

the rostrum; basally extending up onto the head, although sometimes interrupted at a point between the eyes; lateral sulci broad, rounded at bottom, nearly straight, widening markedly toward the base of the rostrum. Head rounded, the ridges above the eyes prominent, tuberculate. Elytra slightly inflated, humeri dentiform; elytral intervals 2, 4, and 6 greatly elevated, a conspicuous tubercle apically at the end of 4, at the junction of 5 and 6, and a smaller one at the junction of 2 and 8. Strial punctures small, round, distinct, each with a small white seta; a secondary system of extremely large, deep punctures upon the elytral intervals gives an irregular, "warty" appearance; setae upon the intervals, head, and rostrum flattened, recumbent, brown except at sides and apices of elytra, where they are white. Vestiture throughout imbricate. Legs rather stout and short, hind tibiae subtruncate.

*Measurements in millimeters.*—Length about 4.5 to 6.5.

*Female genitalia* (fig. 77, *a*, *b*, *c*, *d*).—Genital tube tubular, semi-

membranous, with two dorsal rods, or baculi, of heavy chitin. The apical plates are curved, concave dorsally, having a tubular appearance.

*Male genitalia* (fig. 77, *e, f*).—Median lobe thick, evenly curved from base to apex, very deeply excavated apically to the median orifice.

*Type locality*.—Southern part of California.

Specimens have been examined from the following localities, all in California: Orange County (A. C. Davis); Pasadena<sup>a</sup> (A. C. Davis); Cabazon (A. C. Davis); Aguanga (A. C. Davis).

[The National Museum collection contains a considerable number of *Rhigopsis* specimens from various places in the southern part of California, which Davis had not examined.]

#### RHIGOPSIS SIMPLEX Horn

*Rhigopsis simplex* Horn, 1894, p. 442.

Form much as in *R. effracta* LeConte, but appears to be slightly more flattened above. Head gray-brown, pronotum grayish, with a wide central and two narrower lateral stripes brown; elytral disk brown, mottled with blackish, sides of elytra gray or gray-brown; legs and body beneath gray to light brown. Rostrum stout, constricted basally beneath, markedly arched above, separated from the front by a transverse groove. Median sulcus sharp, deep, not interrupted apically, extending to the occiput; lateral sulci deep basally, invisible apically. Head with the ridges above the eyes well developed, subtuberculate. Pronotum more than one-third longer than wide, widest at basal fourth; striae slightly impressed, punctures large, round, separate; elytral interval two elevated, and intervals 4, 5, 6, and 7 elevated together, terminating abruptly apically leaving a small tubercle. Vestiture throughout imbricate, scales round or nearly so; setae semierect or erect, brownish on head and pronotum, white on elytral intervals, body beneath, and legs. Legs stout; apices of hind tibiae not truncated, and with a row of large spines at apex.

*Measurements in millimeters*.—Length 5.0; width 2.3.

The genitalia of this specimen seem to be identical with those of females of *R. effracta*.

*Type locality*.—Calmali Mines [Lower California].

The above description is that of a single female specimen in the collection of the U. S. National Museum, collected at San Ysidro, Calif., May 25. It was found alive upon *Neomammillaria* sp. from Lower California.

[Horn (1894, p. 442), after describing *Rhigopsis simplex*, says: "This species may be known from *effracta* by the absence of tuberosities, the feeble elytral costae and the almost entire absence of lateral rostral sulci."]

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